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APRIL 1935

The Basin Method of Planting Row Crops - - - - - - - - - - - - *Shedd, Collins and Davidson*

Power Requirements and the Efficiency of Threshing Machines - - - - - *Silver and McCuen*

Developing Machinery to Control the Field Bindweed - - - - - - - - - - *C. W. Smith*

Portable Elevator as a Labor-Saving Device - - - - - - - - - - - - - - - *Atkeson and Beresford*

Refinancing of Drainage and Irrigation Districts - - - - - - - - - - - - - *Emil Schram*

VOL 16 NO 4

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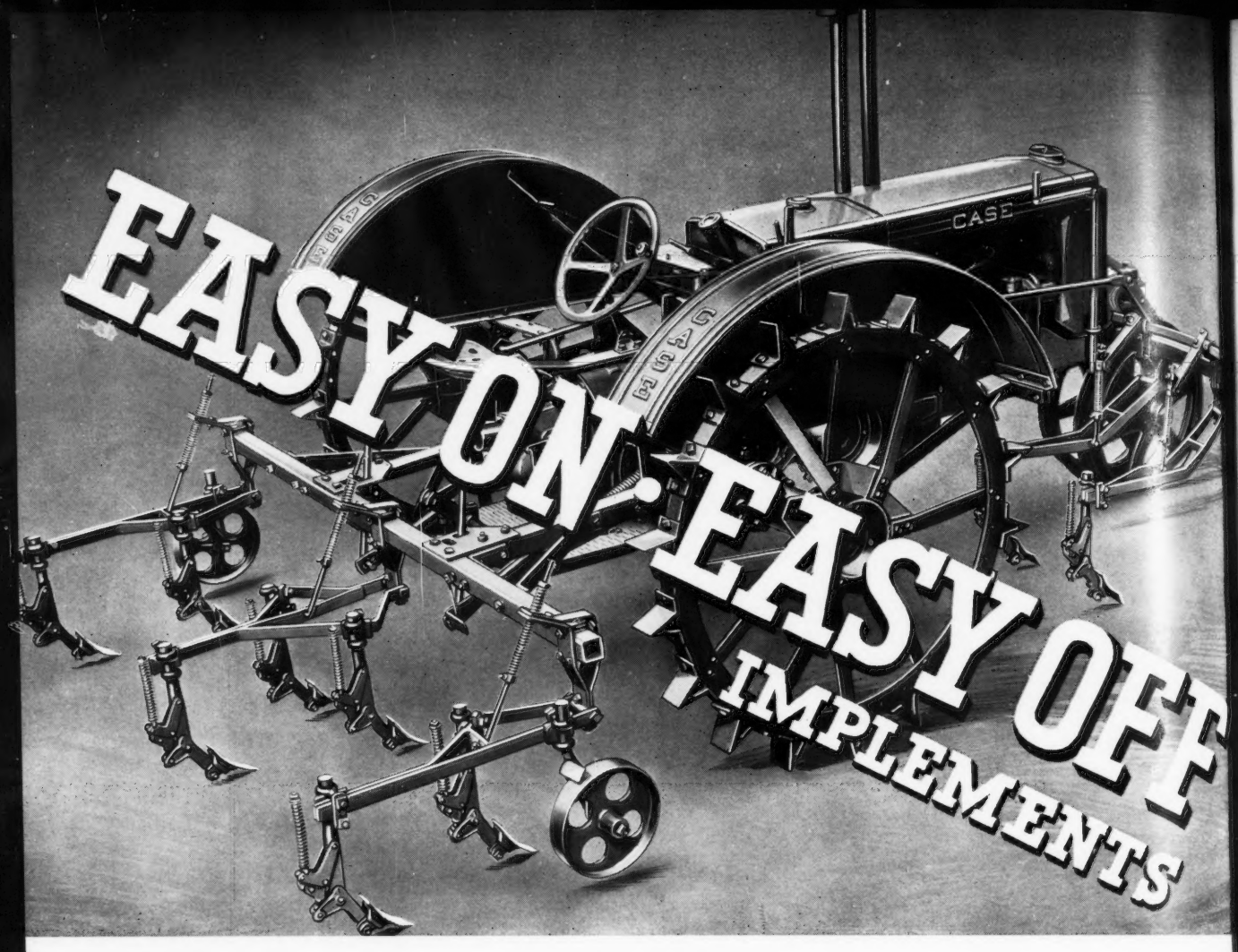

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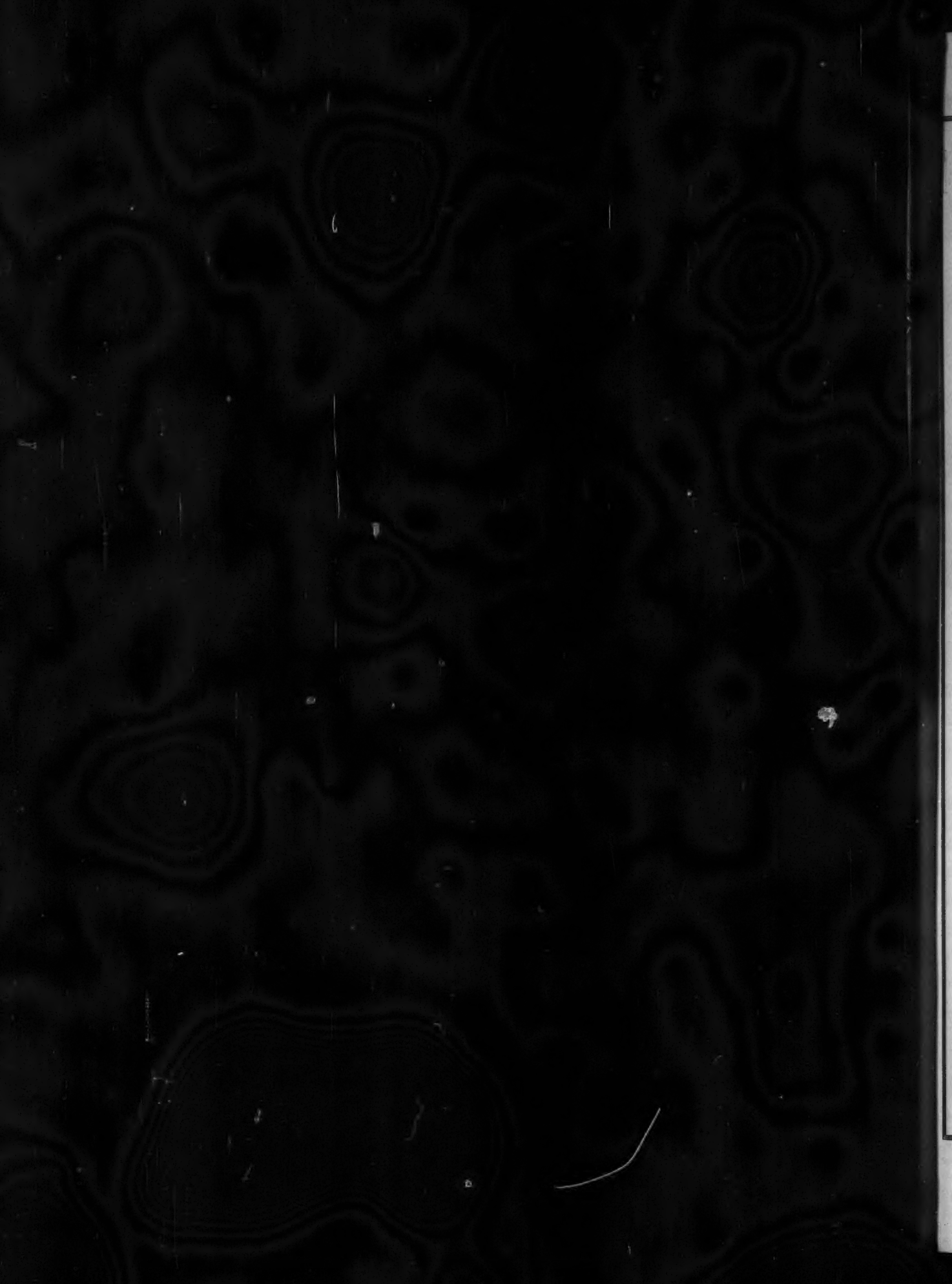

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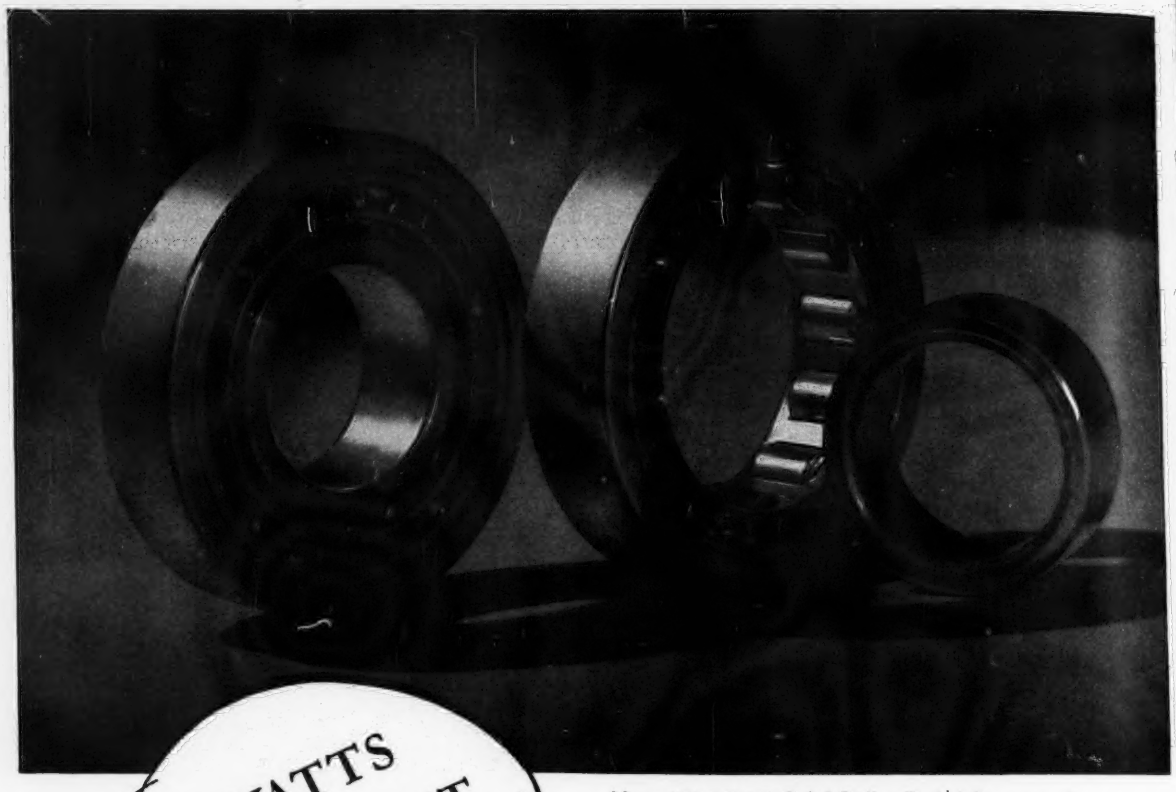

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AGRICULTURAL ENGINEERING

VOL 16, NO 4 EDITORIALS APRIL 1935

"Soil on the Move"

"SOIL ON THE MOVE has the ability to destroy; it covers—it strangles out vegetables—when covering large areas, it affects climate. It does no good to look backwards. Of course, the native vegetation should not have been disturbed, but it has been; so let's look ahead.

"The time for this country to consider the seriousness of this problem is right now. We have had entirely too much independence in this country, as far as the individual having full control of factors which vitally affect the long-time prosperity of this country is concerned. We are worried now somewhat about a few people controlling finances or credit; and the government is out to extend credit to people who need it. We could well afford to be more constructively concerned about the use of our soil and water by the individual thinking only of his immediate prosperity. There is really no one to blame. The system we have worked under was necessary to the opening up of this country. It is simply that the time is now here when there must be a change."

So runs part of a letter, which the editor was privileged to see, between two members of the American Society of Agricultural Engineers of prominent yet widely different place. With abridgement for brevity and to avoid personal references, we quote further because we believe it reflects some views of a considerable and qualified part of the profession of agricultural engineering.

"Most soils can be handled in such a way as largely to prevent blowing. I never have forgotten a simple statement of a Russian peasant when he told me that 'a disk poisons the soil.' After considerable inquiry among the agronomes I learned that what this peasant meant was that, when he substituted a disk for his moldboard plow and springtooth harrow, he destroyed the granular structure of his soil, making it fine and easy to blow, and difficult to till. The action of the one-way disk in our wheat areas should be studied to determine any possible effect of its use on soil blowing.

"A second factor in the control of blowing is a matter of cropping methods. Last spring I drove . . . . through one of the worst dust storms . . . . . The dust was so thick that for miles at a time we could not see beyond the radiator cap of our car. We steered by looking up through the dust clouds to the tops of telephone poles. The day after this storm I travelled . . . . . through much of the area affected by blowing. I saw entire fields where all the top soil had been blown off. A farmer had maintained stubble in strips about one-quarter mile wide, alternating these strips with the fallow soil. A study of these strips showed that loose soil would blow into the stubble strip about four to five rods, and then stop. There was practically no blowing on his farm, except at the boundaries. In one place a stubble field lay along the road. Here the soil coming from fields up the wind had been deposited over about one-half the width of the strip.

"Another factor which has contributed to this problem is the lack of full cooperation between the groups of scientists among which the entire science of agriculture has been partitioned. The control of soil blowing is a cooperative project including, at least, soils, plant science, and engineering. My general observation of our soil scientists is that they have spent much time studying soil nutrition and have slighted somewhat the very necessary study of soils physics. I believe you noted in Europe the great extent to which their soil scientists had studied physical properties of soils. For this reason we might well look to other countries for information as to controlling soil blowing.

"I have recently learned that one of the beneficial by-products of the so-called level-type terrace in Texas and Colorado has been the tendency to control blowing. I am inclined to think that the level terrace, which holds water, provides a wetted strip which supports more vegetation, thus tending to build up effective wind-breaks or barriers. I recalled the controlling of wind erosion in the San Joaquin Valley was aided by the planting of bamboo and other tall and rank-growing vegetation at regular intervals at right angles to the direction of the prevailing winds . . . .

"It was their general feeling that the planting of some grass, such as crested wheat grass, should be undertaken. Ponds should be built to impound surface run-off water. With a grass covering and water in ponds a livestock industry could be started again. Level terraces might be used to concentrate water and thus give the grass covering a chance to start along the terrace channels.

"As we look back through history there is no doubt but that wind and water erosion has caused either the moving of an entire civilization to a new area, or has destroyed the very civilization itself. There is no reason why this should happen again. We now have the ability to command vast amounts of concentrated power which was not available to our ancestors. We are now able to move over a wide area without encountering hostile tribes or nations which will destroy us. We will not starve if the areas affected are taken out of cultivation."

Join Hands on Erosion Control

COOPERATION among the various branches of agricultural science dealing with soil erosion control, and the added emphasis on weak phases of soil administration, should be advanced by the transfer, announced March 27, of the Soil Erosion Service to the U. S. Department of Agriculture. No doubt this implies a changing objective from that of an emergency relief agency to that of a long-time service to the national welfare as affected by agricultural conditions and practices.

According to the official announcement of the USDA Press Service, there is to be integration of activities among the Soil Erosion Service, ECW camps doing soil erosion control work, the AAA, the Forest Service, the Bureau of Chemistry and Soils, and the Bureau of Agricultural Engineering. (The new consolidated unit will be officially known as the "Soil Erosion Service.") The desirability of such correlation has become increasingly apparent. To this task the Department of Agriculture brings a background of

experience and relationships, notably with state agricultural institutions and agencies, which is invaluable.

As a professional society with its membership controlled only by personal qualification and its activity dictated purely by *de facto* subject matter, the American Society of Agricultural Engineers is utterly impartial among agencies of government, and, for that matter, among private or commercial interests, and so has no concern as to alignment of bureaus or departments. But it is also true that agricultural engineers feel most keenly the interlocking of all phases of agricultural science, and so will welcome any betterment of organization which will add to the efficiency of their manifold contacts and cooperation. For this reason we believe the profession will approve the unification of soil erosion control agencies.

Water vs. Water Erosion

DESPITE THE GRAVITY of the disaster to the areas swept by wind erosion this spring, and to some measure a year ago, it seems fair to call it an acute and exceptional condition, as compared to water erosion which is chronic and regular. Besides being unusual, a few thousand tons of soil filtering into metropolitan newspaper offices and mantling the halls of government command more attention than millions of tons dumped into the Mississippi River delta.

To be sure, blowing has long been a plague of the Plains farmer. He has combatted it, somewhat successfully, by rough tillage and protective cover. That the winds went amuck this spring is ascribed mainly to the drought of last summer, with its ensuing shortage of both moisture reserve and plant residues. So regarded, the wind erosion problem becomes in part a matter of water regulation which, in turn, is the essence of soil erosion control work in its more usual sense.

That there is almost no wind erosion in the regions where terracing is widely practiced is to be explained mainly in terms of precipitation. But scattered observations, as referred to above, that suitably terraced spots in the wind-eroded regions stand out something like oases, are significant. To a degree, then, wind erosion control is a matter of hydraulics, and to that degree is land reclamation as known in agricultural engineering.

Also, with what may be provident coincidence, comes basin listing as discussed by Messrs. Shedd and Collins at the last ASAE Power and Machinery Division meeting. (Their paper on this subject appears elsewhere in this issue.) Both as to surface roughness and moisture retention it holds promise as a weapon against wind erosion that should be fully explored and developed.

These distinctly engineering expedients call for close cooperation with soil and plant scientists. The apostles of vegetative cover may find in wind erosion a much more fruitful field for their genius than in erosion by water. In relation to the economics of the soils and crops involved, and to the psychology of the farmer, vegetative methods may be so promising as to claim first place with engineering in a secondary role. Be their part primary or secondary, agricultural engineers will continue to demonstrate their capacity for cooperation with other scientists in the interest of national welfare as affected by agriculture.

Remote Control of Floods by Terracing

WHILE THE EYES of the nation, figuratively and literally, have been filled with dust, it should not blind us to the recurrence of floods, destructive alike to life and property, in the lower reaches of the Mississippi and other river valleys. Concurrence of dust and flood is proof enough of national or, more properly, continental maladjustment of moisture. It challenges the doctrine of rugged individualism in land utilization at the same time that it reduces to a legal fiction the deed which assures perpetual enjoyment of a farm while its soil soars to the Atlantic seaboard or washes to the Gulf of Mexico.

In one of his routine reports to the ASAE Land Reclamation Division, published some months ago in these pages, C. E. Ramser included data from the federal erosion control experiment station at La Crosse, Wisconsin, in the upper valley of the Mississippi. Terracing there reduced the run-off water by 45 per cent. No doubt certain residents of Louisiana would welcome a reduction of 45 per cent in the volume of water coming from up-river.

Obviously it would not be engineering to assume that the crest of a flood at New Orleans bears or could be made to bear a straight-line relation to run-off as measured at La Crosse. It would be both engineering and sound national policy to pursue studies which will establish such relationships and construe their possibilities in economic terms.

Finance Appraises Farm Machinery

CITING the well-known ratio of 75:25 for agricultural and all other population, and its inversion in a hundred years, also the reduction in hours and severity of farm labor, all arising from machine methods, the National City Bank (New York) letter for last December went on (italics ours) to say:

"It is said that these changes have been of greater benefit to the consumers of the cities than to the farmers, and in the aggregate of benefits no doubt this is true, but the standard of living for the entire population was raised by the release of labor from the farms to develop the urban industries. In considering any national problem it is necessary to think in terms of the entire national family. In its case, as in the case of a single family, the less time it must give to procuring the mere necessities of life, the more time it will have for the pursuit of other ends.

"And so, notwithstanding the depressed state of agriculture at this time, which we repeat has been primarily and chiefly caused by the War, it is assuredly true that the *development of the implements of agriculture and of the means of transportation across continents and seas, has done more to ameliorate and improve the living conditions of the masses of mankind than all other developments of the time together,* because all of the other developments were dependent upon a release of labor from the primary needs."

The Basin Method of Planting Row Crops and a Basin Lister Planter[1]

By C. K. Shedd[2], E. V. Collins[3], and J. B. Davidson[4]

THE BASIN METHOD of planting row crops and an experimental basin lister for planting by this method were developed at Ames, Iowa, in 1933 as a result of work under a research project in corn production machinery which is cooperative between the Agricultural Engineering Section, Iowa Agricultural Experiment Station and the Bureau of Agricultural Engineering, U. S. Department of Agriculture.

The purpose of this paper is to describe the basin method of planting and the basin lister, to call attention to some of the obvious advantages of this method of planting, and to briefly discuss its probable utility. It should be clearly understood that the method of planting herein described is experimental and has not yet been sufficiently tested to justify definite recommendations regarding its use. As yet no manufacturer is making or selling such an implement.

Historical. Students of crop culture, soil erosion, and soil moisture conservation have generally recognized that some advantages may be gained by the use of certain cultural methods which keep the surface of the soil rough or furrowed in such a way as to retard run-off.

Contour farming as a method of retarding run-off has been advocated for many years past, and it has come into extensive and successful use in some sections of the country in combination with terracing and more recently in combination with strip cropping, the strips being accurately located on contour lines.

In 1931 Wood[5] suggested the possibility of damming lister furrows in order to assist in conserving moisture and controlling erosion. C. T. Peacock developed and in 1931 patented a summer fallow cultivating machine comprising a furrow-forming member and a mechanism for forming dams at regular intervals in the furrows. He has used this machine on his farm near Arriba, Colorado, and claims decided benefits in moisture conservation. In 1930 the Bureau of Chemistry and Soils, U. S. Department of Agriculture, built and used at Hays, Kansas, a "waffle" cultivator comprising cultivator shovels which were alternately raised and lowered so as to form holes in the surface soil. This machine is still being tested.

The Basin Method. The basin method of planting consists of placing the seed in basins formed in the surface soil. The purpose of these basins is to catch and hold rainwater, thus causing it to soak into the soil near the point where it falls. In the experimental work at Ames, the basins were formed and the seed planted by an experimental basin lister which first opened a lister furrow and planted the seed, then formed transverse earth dams at regular intervals in the furrow. Fig. 1 is a longitudinal section showing the location of dams in the furrow and the seed at the bottom of the basin between dams. It is not yet known whether the seed should be located as shown in Fig. 1, or if it might as well be drilled continuously in the furrow, or if under some conditions it might be best to place all of the seed in the dams.

Fig. 2 is a view of a field listed by this method. The picture was taken about eight hours after a 3.2-in rain of high intensity.

The Basin Lister. The basin lister is shown at work in the field in Fig. 3. It comprises a corn lister such as now commonly used in some parts of the corn belt, together with a damming mechanism attached to the rear of the lister which forms transverse earth dams at regular intervals in the lister furrow, thus converting the furrow into a series of basins.

Fig. 4 is a top plan view of the basin-forming attachment or damming mechanism, Fig. 5 is a side elevation, and

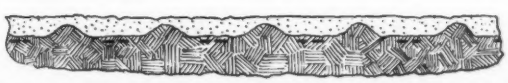

Fig. 1 Longitudinal section of basin-listed furrow indicating seed placed in the bottom of the basin

Fig. 2 (Left) A basin-listed field after a 3.2-in rain. Fig. 3 (Right) A basin lister at work

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[1]Paper presented at a meeting of the Power and Machinery Division of the American Society of Agricultural Engineers at Chicago, December 1934. Journal Paper No. J163 of the Iowa Agricultural Experiment Station Project No. 22.

[2]Agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. ASAE.

[3]Research professor of agricultural engineering, Iowa State College. Mem. ASAE.

[4]Professor of agricultural engineering and head of department, Iowa State College. Charter Mem. ASAE.

[5]The future of moisture conservation. Ivan D. Wood, AGRICULTURAL ENGINEERING, June 1933.

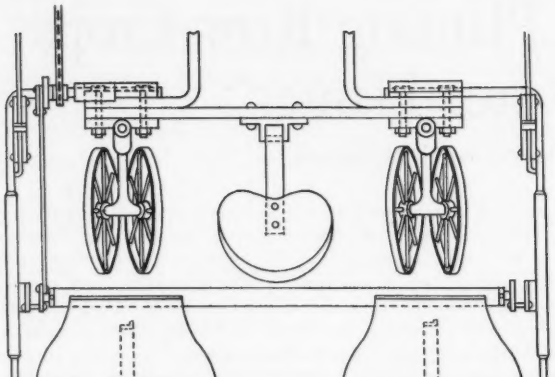


Fig. 4 Plan view of basin-forming attachment for lister

Fig. 6 is an enlarged side elevation of the scraper releasing mechanism.

The paddle-wheel scrapers shown at the rear are positioned to run in the lister furrows. The paddles or blades of the paddle wheels are shaped to fit the bottom and sides of the furrow. In operation, as the lister moves forward, the paddle wheel is held from rotating with one of the paddles nearly vertical in the furrow while it scrapes dirt from the bottom and sides of the furrow to form a dam. The release of a paddle wheel permitting it to rotate one-quarter revolution, at regular intervals, dumps the dirt collected and forms the dams in the furrow. The mechanism for holding and releasing the paddle wheel is clearly shown in Figs. 4, 5, and 6.

Another form of releasing mechanism, shown in Fig. 7, utilizes an automobile shock absorber of the single-acting, ride-control type instead of the chain-driven mechanism shown in Fig. 6. A roller mounted on the shock absorber arm engages a blade of the paddle wheel and holds the wheel from turning. Pressure of the paddle gradually forces the shock absorber arm and roller out of engagement and thus releases the paddle wheel. The shock absorber arm and roller return to the unloaded position in time to engage the next paddle so that the paddle wheel is permitted to turn only one-fourth revolution each time it is released. The distance between dams may be changed by means of the ride-control adjustment on the shock absorber.

The paddle wheel is attached to the lister by means of an axle shaft which extends from the paddle wheel hub out to the side far enough to clear the paddles, then bends and extends forward to a point opposite the rear part of the lister frame where it bends inward and is journaled in a bearing attached to the lister frame. By this construction the paddle wheel is held down by its own weight and is free to move vertically to automatically adjust its position to uneven ground surface.

1933 and 1934 Experiments. The basin lister described above was built in the spring of 1933 and was used in growing about 15 acres of corn that year on the agricultural engineering experiment farm at Ames. The field was blank-basin listed about the middle of April and left in that

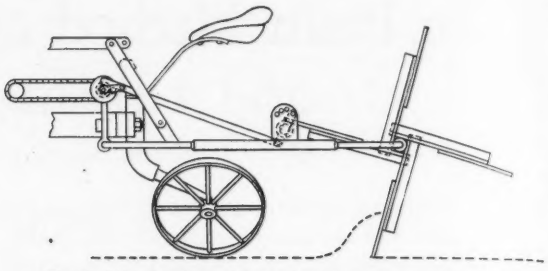


Fig. 5 Side elevation of basin-forming attachment for lister

condition until the latter part of May. Part of the field is shown in Fig. 2 after a heavy rain on May 19. As soon as the ground was dry enough to work after this rain, it was double-disked and then planted with the basin lister splitting the ridges. This field was used for preliminary trial of different methods of cultivating.

The yield of corn, 92.8 bushels per acre, was considered to be very satisfactory, but the work was not set up to obtain any definite comparison with other methods of planting.

In 1934 it was planned to carry on some careful experiments with the basin lister on the agricultural engineering farm at Ames. These experiments were designed (1) to compare yields for basin listing, ordinary listing, and surface drill planting, (2) to determine labor and power expenditures in producing basin-listed corn, and (3) to compare implements for cultivating basin-listed corn.

A record-breaking drought occurred at Ames in 1934. From the latter part of September 1933 when the ground was prepared for these experiments until July 1, 1934, there was no rain that caused any run-off; consequently the basins had no opportunity to conserve rainfall. There was no effective rainfall between April 1 and July 1.

The results of the yield comparison were as follows: The listed and basin-listed corn yielded alike, 8 bu per acre, and the drill-planted corn yielded 11 bu per acre. Due to the dry condition of the soil at planting time, the drill-planted corn was put in with a planter equipped with disk-furrow openers. This placed the seed in a small furrow deep below the original ground surface. The drill-planted corn made good growth in June but dried up in August. Both kinds of listed corn were badly stunted in June but made fairly good growth in the late summer. The difference observed in yield might easily have been reversed, if a little different technic had been followed as to depth of covering the seed. Due to the extremely unusual weather conditions and the low yields secured by all three methods of planting, these yield results are not thought to be of any significance.

The records of labor and power used in producing basin-listed corn showed that the labor and tractor time were the same as for ordinary listed corn. The damming attachment of the basin lister of course adds something to the draft of the implement. A few draft tests were made of the lister with and without the damming attachment. It was found that the soil and depth variations from one furrow to the next in some cases more than offset the draft of the damming attachment, indicating that the draft of the damming attachment was small in proportion to the draft of the lister. A two-row lister with damming attachment was pulled satisfactorily with a two-plow tractor.

In addition to the experiments at Ames, the basin lister was given a preliminary trial on different soil types at several locations in Iowa by basin-listing small plots in

farmers' fields for comparison with corn that they grew by their own method of planting. The results secured are shown in Table 1.

TABLE 1

Location	*Rainfall in cultivation period, in	Yield, bushels per acre		
		Hybrid seed, basin-listed	Farmer's seed	
			Basin-listed	Surface-planted
Cherokee	June 6 — 0.9 June 7 — 3.0 June 8 — 1.2 June 20 — 0.5	47.5	32.3	30.5
Storm Lake	June 6 — 1.5 June 8 — 2-4 June 17 — 0.5	61.6	42.0	42.4
Eldora	None	43.8	24.9	55.8

*Rainfall between time of planting and last cultivation, ineffective showers not counted.

The soil was dry at the time of planting and for at least three weeks thereafter on each of these areas. Poor stands of corn were generally secured where the seed was covered to the usual depth. Hybrid seed produced better stands than farmers' seed. The stands secured by surface planting were somewhat better than by basin-listing which may have been due to difference in depth of covering the seed. On the Cherokee and Storm Lake fields, the basins conserved some rainfall in June. On the Eldora field there was no rain for the basins to conserve. The surface-planted corn in this field was planted very deep, so deep that it probably would not have come up if there had been any rain to pack the soil over the seed. This deep planting served to place the seed and plant roots so deep that they were in soil containing moisture during June so that the plants were not very much damaged by June drought. The basin-listed seed was covered to normal depth. The soil dried out around the plants, and they were severely damaged by the lack of moisture in June. Later in the summer there was sufficient rainfall to produce a crop where the plants were still in good condition. While the yield of the surface-planted corn at Eldora was more than twice that of the basin-listed corn using the same seed, this is thought to be the result of difference in depth of covering the seed and of erratic weather conditions. The difference in yields at Eldora is not considered a significant indication of the relative merits of the two methods of planting.

In addition to the Iowa experiments, a basin-forming attachment for a four-row lister has been procured by the Division of Drainage and Soil Erosion Control, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Experiments with the use of this implement for land preparation were started at Hays, Kansas, in the summer of 1934.

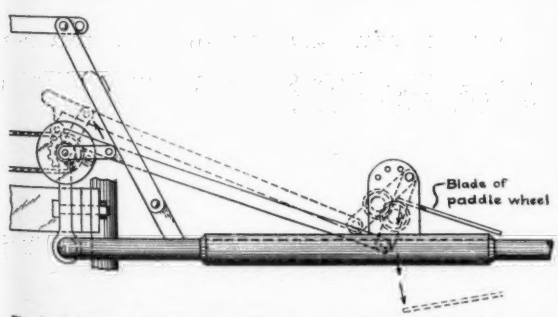


Fig. 6 Details of paddle wheel releasing mechanism. Solid lines show position of parts when paddle wheel is locked, dotted lines when it is released

Cultivation of Corn Planted by the Basin Method. The implements found to be most successful for cultivation of basin-listed corn in 1933 were as follows: The first cultivation was performed with the implement combination shown in Fig. 8. This is a 14-ft, single-disk harrow with the gangs set at only a slight angle together with an experimental rotary-hoe attachment comprising three rotary hoe wheels flexibly mounted to run on each row of corn. The disk harrow cultivated the ridges and rolled about the right amount of dirt into the basins to cover small weeds. The rotary-hoe attachment cultivated the dams and the bottoms of the basins. The disk harrow without rotary-hoe attachment was used on part of the field and was found to give good control of weeds, so the need for the rotary-hoe attachment is doubtful.

For the second cultivation the disk harrow was used without the rotary-hoe attachment.

The third and fourth cultivations were performed with a two-row tractor cultivator shown in Fig. 9. This cultivator was equipped with a pair of disk hillers and four sweeps or shovels per row. For the third cultivation the disk hillers were set to cut the edges of the ridges, throwing the dirt away from the corn as shown in Fig. 9. The shovels back of the disks rolled dirt back into the disk tracks and some dirt into the basins. For the fourth or last cultivation the disk hillers were set to throw dirt toward the corn. This last cultivation filled the basins nearly full.

In 1934, due to dry condition of the soil, the spike-tooth harrow was found to be the preferred implement for the first cultivation. The second and third cultivations were performed with the cultivator shown in Fig. 9.

By using implements as explained above, it was found possible to effect very good control of weeds and to maintain basins of good capacity up to the time of the last cultivation. Even at the last cultivation it would not have been necessary to entirely fill the basins with dirt.

Another implement tried in 1933 was a listed corn cultivator of the ordinary type which is briefly described as follows: The frame of the cultivator is supported and held centered on the row by two "gong" wheels which run in the lister furrow. The cultivating parts comprise two disks and two shovels for each row. For the first cultivation with this implement, the disks were set to cut the edges of the ridges throwing the dirt out away from the corn, and the shovels were set just back of and outside of the disks. This cultivator did good work except that the effective height of the dams in the furrow was reduced about one-third by this cultivation.

Water-Holding Capacity of Basins. Measurements of

Fig. 7 Shock absorber type of releasing mechanism for paddle wheel. There is no chain or gear-driven parts

basins on ground planted with the basin lister adjusted to make dams 4 ft apart and having an effective height of 5 in showed that on level ground the basins have capacity to hold 1.16 in of rainfall plus the amount that soaks into the soil during the rain. This capacity would be reduced very little on sloping ground, provided the crop rows were run approximately on contours where cultivation up and down the slope would be likely to result in soil erosion.

Advantages of the Basin Method of Planting. So far as these observations and experiments go, they indicate that basin planting, in conjunction with contour farming where the latter practice is desirable, obtain the following benefits:

1 Reduces water erosion of the soil

2 Lessens the danger of washing out seed or small plants

3 Reduces the tendency for water to accumulate in ponds at low points in relatively flat fields

4 Conserves moisture in the following ways:

(a) In case of a heavy dashing rain, the water is held in place until it soaks into the soil where it is available for use by plants during dry periods. In reasonably open, deep soils it is seldom that the full moisture storage capacity of the soil is utilized.

(b) It conserves some moisture from so-called ineffective showers of, say, ¼-in rainfall. With level cultivation such light showers result in the water either running off or else soaking into the soil so near the surface that it is soon evaporated and therefore is of little use to plants. When the basin method is used, such light showers will usually result in some water running off from the ridges into the basins. The water is thus concentrated near the plants and reaches a sufficient depth in the soil to be better protected from evaporation.

(c) By blank listing in the fall with the basin-forming lister, some moisture from light snowfall can be conserved. The basins will be filled with snow before it begins blowing off of the field.

In addition to the benefits stated above, the basin method of planting should be effective in reducing wind erosion of the soil and protecting small plants from the whipping and cutting action of heavy winds carrying small particles of soil.

Basin-lister planting should be almost as economical in the use of labor and power as ordinary lister planting.

Probable Utility of the Basin Method of Planting. While observations and experimental data so far are not sufficient to justify definite recommendations as to the utility of the basin method of planting, it would seem to be adaptable for use wherever ordinary lister planting is now the preferred method. Its most important advantages over other methods of planting would be expected to appear in regions where rainfall is the limiting factor in crop production. The basin method may also prove to be best in many areas that are now surface planted. The expected advantages are less labor in producing the crop, better conservation of soil and moisture, and relief from the formation of ponds in relatively flat fields.

It should be remembered, however, that ordinary lister planting is well adapted only to a rather deep, porous soil. This is probably true also of basin-lister planting. If the seed is to be placed in the bottom of a furrow 4 in deep, the soil at that depth must be sufficiently fertile to support the early growth of the plants. Since the function of the basins is to cause a larger part of the rainfall to soak into the soil, they cannot be expected to perform very well in an impervious soil. Where the top soil is thin, or where there is a very tight subsoil, or where there are drainage difficulties due to seepage or on ground subject to overflow, it seems probable that surface planting is preferable to the basin method of planting.

AUTHORS' NOTE: Acknowledgment is made of the friendly interest and the suggestions regarding the development of the basin method of planting corn made by staff members of the farm crops and soils section of the Iowa Agricultural Experiment Station.

Industrial Outlets for the Farm

INDUSTRIAL OUTLETS for farm products have long been the dream of agricultural engineers and industrial chemists. If we ignore international competition for export markets, and measure the home market for farm products entirely in terms of food that the human stomach will hold and clothing fiber that the human back can wear, it may be admitted that the outlet for the farm is rather limited and inflexible. On such a premise there is some justification for emphasizing price and for efforts to keep prices up. But once we admit the possibility of industrial markets, highly expansible if prices are low enough to compete with alternative materials and deliver an economic value to the consumer, the whole picture is changed. Agriculture no longer will be an exception to the rule that industrial prosperity comes through low prices and large volume.

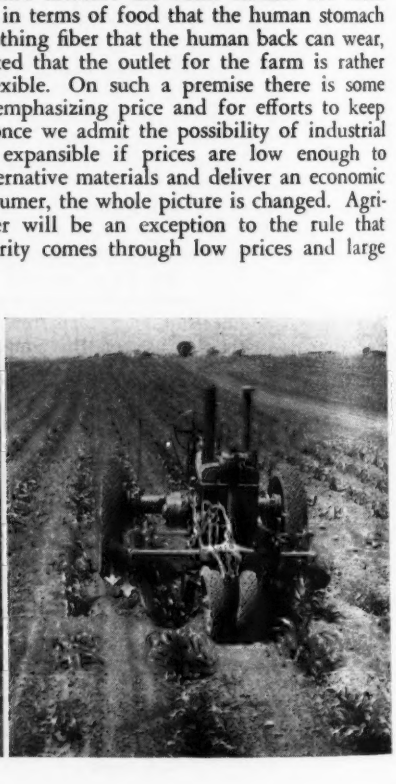


Fig. 8 (Right) First cultivation of corn planted with the basin lister. The implement shown is a 14-ft, single-disk harrow with an experimental rotary hoe attachment

Fig. 9 (Extreme Right) Cultivator used for corn planted with the basin lister

A Study of Power Requirements and Efficiency of Threshing Machines[1]

By E. A. Silver[2] and G. W. McCuen[3]

A STUDY OF POWER requirements and efficiency of threshing machines, made by the department of agricultural engineering of the Ohio Agricultural Experiment Station at Columbus, Ohio, has not been for the purpose of comparing one make of machine with another. The objective has been to obtain certain facts relative to the performance of individual threshers so that the data could be studied for possible improvement of the machine relative to their power requirements and their efficiency in threshing.

It was necessary, therefore, to determine first the power requirements for different zones of the machine such as cylinder, rack and shoe group, blower and other units, as well as to discover the efficiency of the thresher in threshing, separating, and cleaning. Both the power requirements and efficiencies were studied simultaneously.

The testing of threshing machines has been carried on for five years, during which time some changes have been made in the technique of testing.

All the charts and graphs presented in this paper have been given a key letter and number. One of these letters is known to each of the companies who furnished the machines for test and which designates his own machine only. The number represents the year the test was made.

There may arise in the minds of some that different years would give a different ratio between grain and straw. This might be true when taking field samples over a wide area, but the wheat from the Ohio State University farm was very consistent from year to year. Three years of data have given an average of 38.37 per cent wheat and 61.63 per cent straw when considering the whole sample. The greatest variation from year to year was 6.4 per cent. It might be of further interest to know that the average weight of 10-bundle samples in 1932 was 90 lb; in 1933, 89 lb, and in 1934, 92 lb. The grain was stored under cover and allowed to go through a sweat for four weeks before threshing.

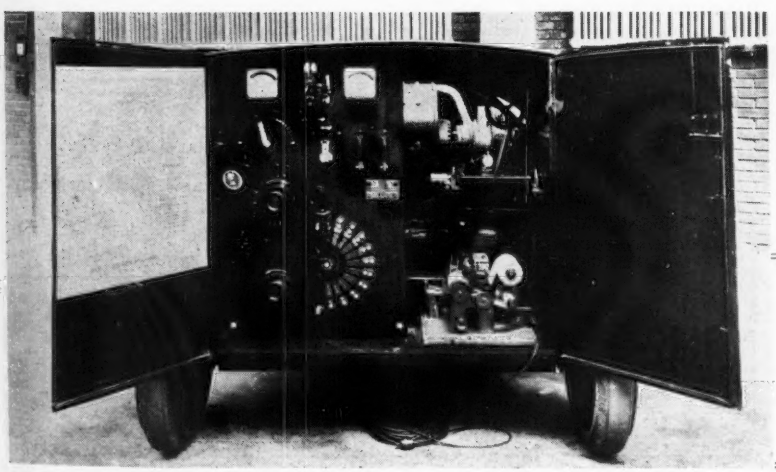
For the past three years 20 sec has been selected for the length of test. We find that this period of time is sufficient to produce accurate results in regard to the performance of the machine. This has been made possible through synchronized control of all mechanical factors of the test.

Testing Equipment and Methods Used. The testing equipment for power requirements of the machine consists of an electric recording dynamometer where the torque and speed of an electric motor is measured and recorded.

In order to eliminate any inconsistencies which may exist in pitching bundles directly into the feeder of the threshing machine, a bundle-metering device was developed. This device has a range of feeding from 4 to 12 tons per hour. It consists of a series of flights spaced so that a bundle can be laid between them and delivered head first onto the feeder rake. A variable-speed transmission on the metering device makes it possible to obtain the different rates of feeding. The rate of feeding may be advanced at regular increments of one, two, or more tons per hour. With this method of feeding it is possible to repeat tests and obtain a very close check.

In order to study the three sources of grain losses—cylinder, rack, and shoe—a means of keeping apart the straw from the rack and the chaff from the shoe was necessary. This apparatus consists of a framework for the support of a standard 6-ft binder platform canvas which catches the straw from the rack and carries it to either side of the machine. A large trap-door deflects the chaff from the shoe either into the shoe box or over it on to the ground. The platform canvas, the trap-door, dynamometer recording device, accessories, and signal light are all synchronized together and controlled by one lever on the device just described.

The platform canvas on the straw and chaff separator is operated by a ¼-hp, 220-volt, d-c motor which receives current from the dynamometer power unit. An open and closed belt, similar to that used on a machine shop planer reversing mechanism is used as a means of changing the direction of motion of the canvas. Before the actual test period begins the straw is delivered to the right side of the



The Ohio electric recording dynamometer for measuring the power of belt-driven machines

[1]Paper presented at a meetng of the Power and Machinery Division of the American Society of Agricultural Engineers at Chicago, December 1934.

[2]Research agricultural engineer, Ohio State University. Mem. ASAE.

[3]Professor of agricultural engineering, Ohio State University. Mem. ASAE.

machine. When the test starts, the motion of the canvas is reversed so that the straw is delivered at the opposite side of the machine and deposited in the large straw box. Simultaneously, with the reversing of the canvas, the chaff trapdoor is also shifted. The shifting of the door directs the material from the shoe into a large box just back of the tailings auger. Thus the straw from the rack and material from the shoe are separated.

The straw in the box is weighed, then fed to the straw elevator which combs it into a thin layer and delivers it to a shaker equipped with a stiff straw rack. As the straw moves over the shaker, all the loose wheat passes through the rack and is caught in a box below. This loose wheat in the box represents the rack losses. As the straw moves over the shaker, it enters the rethresher where any wheat left in the heads of the grain is removed. This represents the cylinder losses. The wheat removed from the material caught back of the shoe represents the shoe losses. Each of these three small samples of grain are then recleaned and graded on a small clipper laboratory fanning mill, then weighed and recorded. During the same period of time that the straw or chaff samples are collected, the wheat which was threshed is caught, weighed, and recorded. These combined weights of straw, chaff, wheat and losses are the basis for the calculation of the rate of feeding. In addition these are the basis for the efficiency of the machines. The rate of threshing for all tests was based on tons of bundles per hour rather than bushels of wheat per hour.

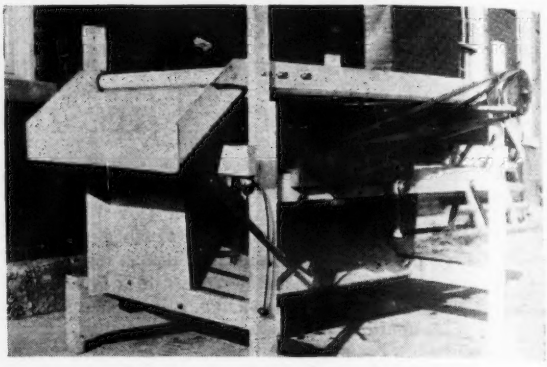
The separator is generally run empty about four hours to reduce the friction load and then under threshing load of 1½ to 2 hr when major adjustments are made. The no-load tests on power requirements are taken both at the start and completion of the tests for each machine. By this procedure a check can be had to determine if the machine is properly broken in. In no instance did we find any variation.

The power requirements of the machines were studied as follows:

1 No-load on the blower at variable rates of speed
2 Entire thresher less the blower
3 Cylinder alone
4 Feeder.

The same division of power was studied for the above units when under load.

The first series of tests following the breaking-in runs consisted of testing at a rate of between 8 and 9 tons of bundles per hour which has been found to be about the optimum rate of threshing for a 28-in cylinder machine. It is equivalent to two men pitching at the rate of 4.44 lb per second, or approximately 15 bundles per man per minute (2 men pitching), or about 20 min to the average load of bundles. Check tests were run for the different settings until the best results were obtained at the 8 to 9-ton rate.



The straw and chaff separator used in the Ohio threshing efficiency tests

The next series of tests consisted of operating the machine at rates of feeding varying from 5 tons to about 12 tons per hour, advancing at either 2 or 3-ton increments. Two arrangements of concaves and grates used were as follows:

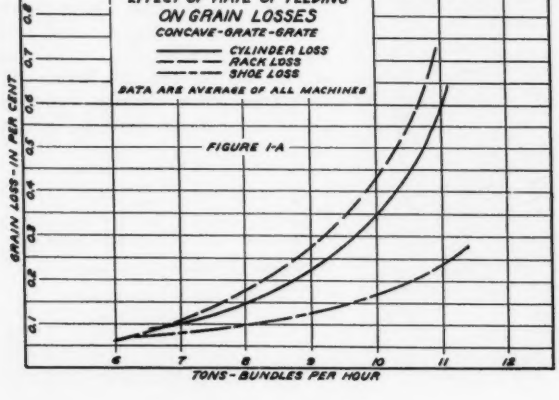
1 One concave and two grates (concave, grate, grate)
2 Two concaves with a grate between (concave, grate, concave).

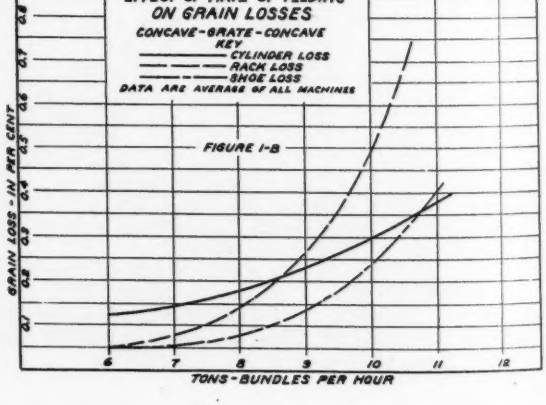
In both cases the concaves were set up full height. This series revealed the critical capacity of the machine, that is, the point in its capacity where the machine became wasteful, either over the rack or over the shoe.

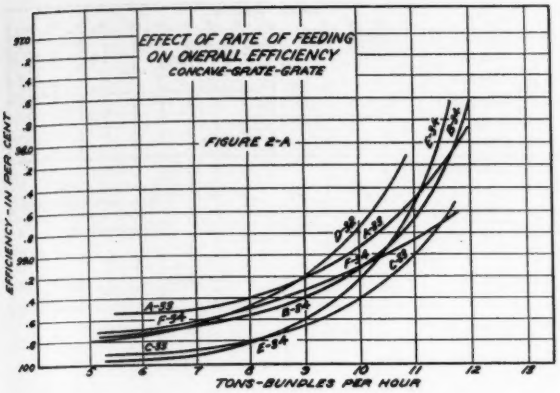
Efficiency and Power Requirements as Affected by Rate of Threshing. It will be seen from Figs. 1-A, 1-B, 2-A, and 2-B that some machines began to be slightly wasteful at 8 tons per hour and that some did not perform poorly until even the 9 to 10-ton rate was reached.

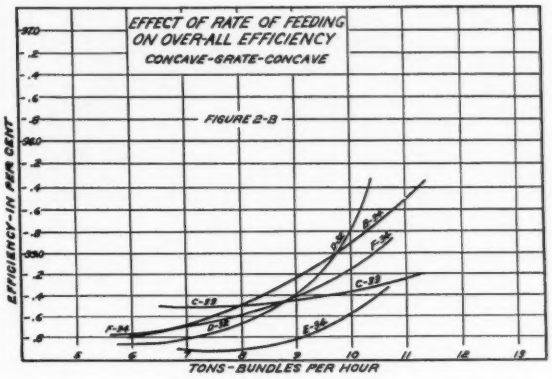
When the two series of tests are compared, it will be seen that the combination of one concave and two grates produced a greater capacity for the same machine. As would be expected, however, the rack and shoe losses were greater when the straw was broken up more by using the extra concave.

No two machines performed alike as one would expect. When the grain losses were decreased in the threshing zone, a corresponding increase was had on the rack. The shoe losses in some instances increased and in some cases de-









creased. There is no logical explanation for these deviations, other than some shoes are better designed and have better air distribution for overloads. It might be well to suggest at this time that the type of fan blind design be given a little more consideration in conjunction with deflector positions.

It is obvious that for the conditions under which the test was made a greater overall efficiency performance is had with the concave-grate-concave combination.

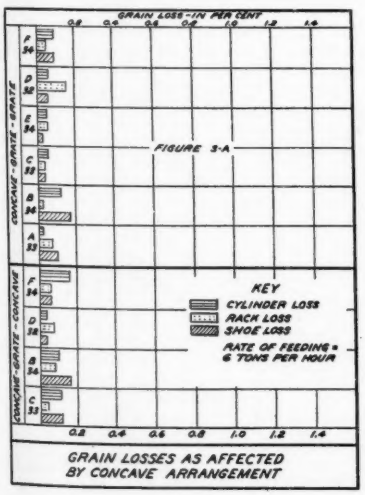
Figs. 3-A, 3-B, and 3-C give a comparison for the three separate losses—cylinder, rack, and shoe. The fact is revealed that the cylinder losses are reduced materially with the extra concave in use. The rack losses are not bad when the concave-grate-grate combination is used, until the critical capacity of the machine is reached which is between 9 and 10 tons. When the concave-grate-concave combination is used, the rack losses begin to accumulate between the 7 and 8-ton rate and increase rapidly as the rate of feeding increases. The shoe losses did not become noticeable until the 8-ton rate was reached. These losses do not increase as rapidly as does the rack loss.

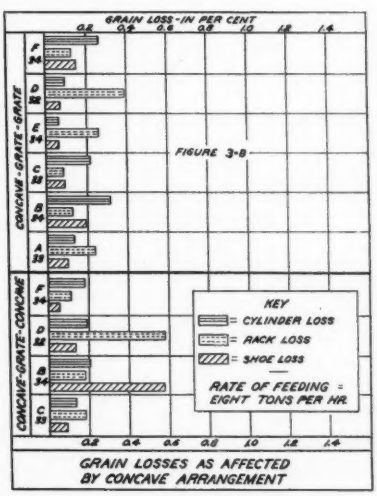
Effect of Speed of Rotary Rack. It has been our observation that the standard speed, or the speed the manufacturer recommends for rotary racks, has not been the optimum. If we eliminate the effect that the type, angle, and position of risers have on rack performance and take the rack as designed, and study the effect of speed, it is readily seen that the speed of the rack is a very important factor when threshing at a conservative rate of 8½ to 9 tons per hour.

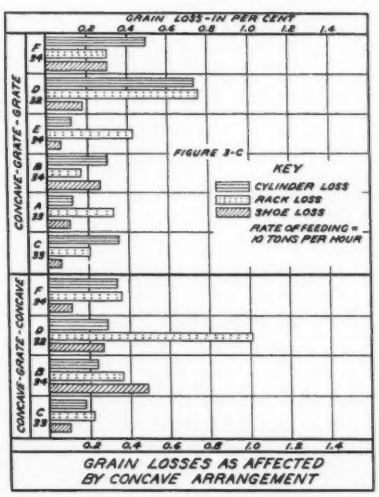
Fig. 4 gives some very interesting facts relative to the range of efficiency of rotary rack performance. If we confine the speed to a narrow range of 10 rpm in the case of the rack studied, we find the optimum efficiency was obtained from, say, 200 to 210 rpm. The recommended speed for this rack was 218 rpm, which probably gives good performance in the field for all conditions, but for any speed higher than 218 rpm the losses were gradually increased. These studies were for a rack which had a 5-in-throw crank.

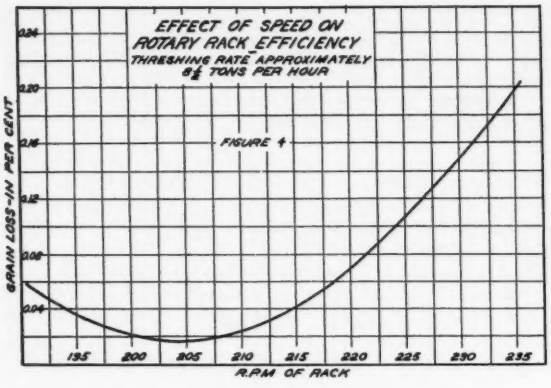
Effect of Careless Pitching on Power and Shelling Efficiency. The average thresherman knows that careless pitching affects the efficiency of the machine. Fig. 5 illustrates the effect on shelling and power consumption from careless or irregular feeding. The rate of feeding selected for these tests was 9 tons of bundles per hour. The data are the average of several machines.

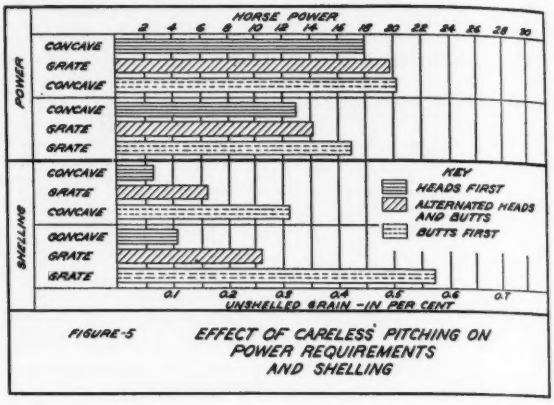
Again it is quite evident that considerable more power is required when the two concaves are used and that a higher shelling efficiency is obtained than when the concave arrangement of one concave and two grates are used. The chart further indicates that considerable more power is required by the cylinder when careless feeding is done. Feeding the bundles heads first to the cylinder required much less power than when the bundles were alternated heads and butts, or when fed butts first. This is true with








EFFECT OF SPEED ON ROTARY RACK EFFICIENCY
THRESHING RATE APPROXIMATELY 6½ TONS PER HOUR
FIGURE 4
GRAIN LOSS-IN PER CENT
R.P.M. OF RACK



both combinations of concave arrangement. Likewise, the shelling efficiency is also greatly impaired by careless or irregular feeding as the following table will illustrate:

POWER REQUIREMENTS OF CYLINDER

Manner of feeding	Concave arrangement	Power required	Per cent increase in power over careful (regular feeding)
Heads first	Concave-grate-concave	18.0	
Alternated heads and butts	Concave-grate-concave	19.8	10.0
Butts first	Concave-grate-concave	20.2	12.2
Heads first	Concave-grate-grate	13.0	
Alternated heads and butts	Concave-grate-grate	14.2	9.2
Butts first	Concave-grate-grate	17.0	30.8

SHELLING EFFICIENCY OF CYLINDER

Manner of feeding	Concave arrangement	Unshelled grain in per cent*
Heads first	Concave-grate-concave	0.068
Alternated heads and butts	Concave-grate-concave	0.162
Butts first	Concave-grate-concave	0.312
Heads first	Concave-grate-grate	0.110
Alternated heads and butts	Concave-grate-grate	0.261
Butts first	Concave-grate-grate	0.571

*Unshelled grain in per cent of total grain in heads.

When the bundles were fed butts first to the cylinder, it was evident that they passed through the cylinder at a much greater velocity than when the bundles were fed heads first. Undoubtedly this condition gives rise to a lessened beating or flailing action, and probably does not increase the stripping action to any great extent. The efficiency of the rack and shoe was also affected by careless pitching but not to such a degree as was the shelling or threshing efficiency.

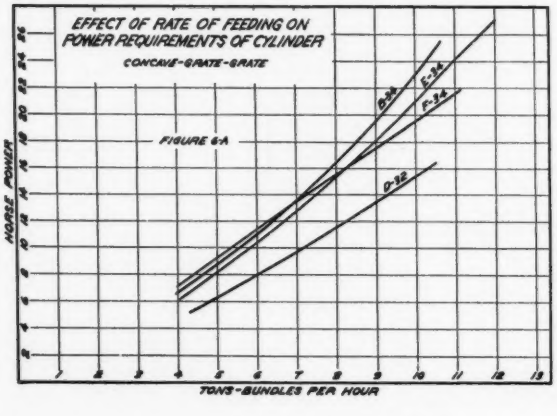
Effect of Height of Feeding to the Cylinder. Our field experience in attaching and setting feeders led us to feel that the height of feeding had a great deal to do with the power requirement of a machine. It was with this thought in mind that a series of tests were run to discover whether or not the height of feeder had any influence on power consumption of the cylinder. A series of tests was run with the tip of the feeder pan in the following positions:

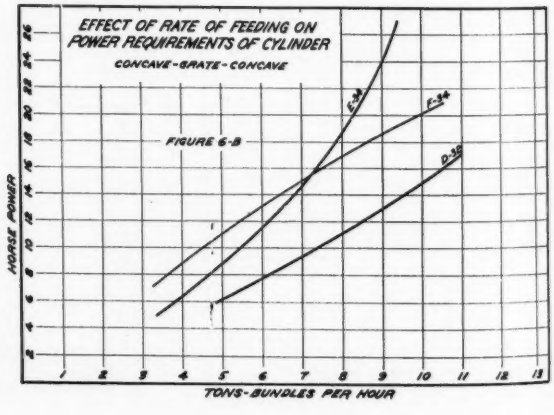
	Distance above cylinder shaft	Average distance away from cylinder shaft
A	2½ in	12½ in
B	5½ in	12½ in
C	8½ in	12½ in

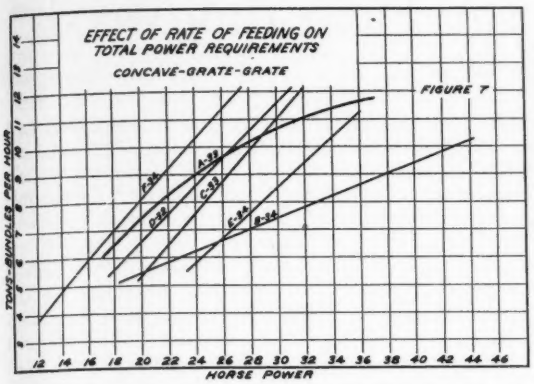
The following table will illustrate the effect of height of feeding with feeder setting "A" as 100 per cent.

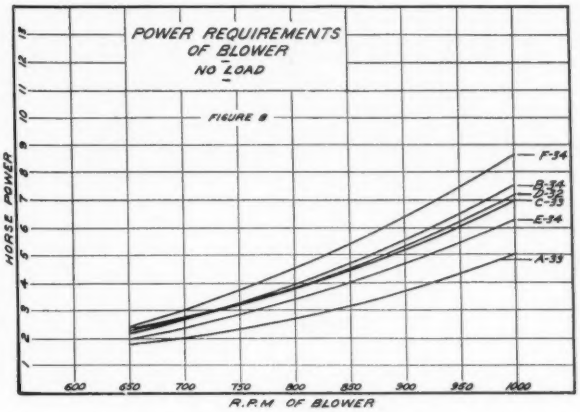
Feeder setting	Horsepower per ton-hour	Per cent
A	1.06	100.0
B	1.15	108.5
C	1.47	138.7

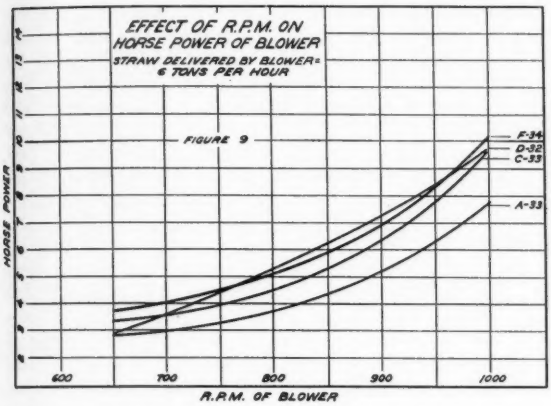
Power Requirements of the Cylinder as Affected by Rate of Feeding. It will be remembered from previous power discussions that the rate of feeding had a marked influence on the power consumption of the whole machine and its

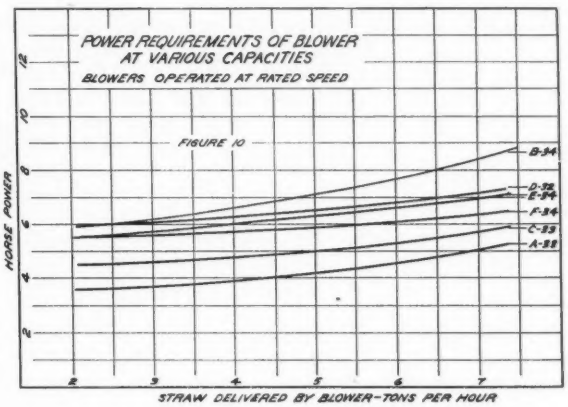




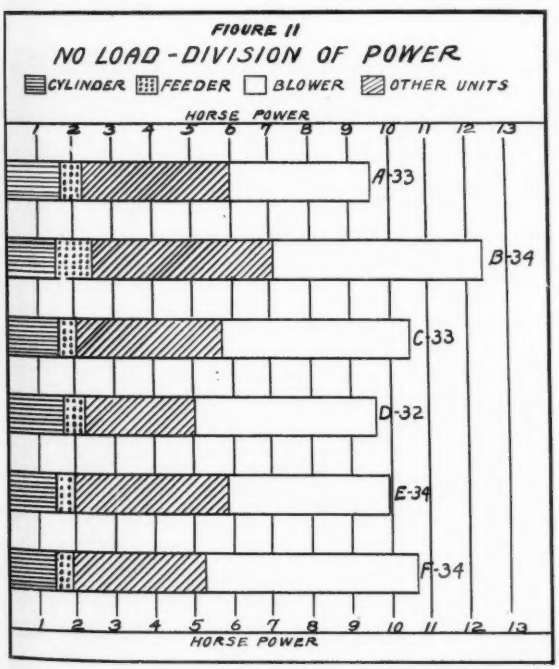








efficiency. A study of division of power of the thresher indicated that about 50 per cent of the total power requirement was consumed in the cylinder. It also was found that two concaves gave a higher efficiency in shelling the grain out of the heads, but as a general rule the rack and shoe efficiency dropped slightly with this arrangement. Figures 6-A, 6-B, and 7 show the power requirements of the cylinders of different machines with the two concave arrangements. Some of the machines did not perform as consistently as others as we find a rather wide spread in the power consumed on some of the threshers. Again the concave-grate-grate arrangement required less power than the concave-grate-concave arrangement.



Windstacker Power Requirements. The power requirements of all windstackers was very consistent. Fig. 8 gives the no-load characteristics of the fans at varying rates of speeds. The low fan speeds are very consistent but a spread in power requirements is noted as the speed is increased. The average speed of all fans was about 875 rpm.

A series of tests when 6 tons of straw per hour was being delivered by the fan with varying speeds gave a characteristic curve somewhat similar to the no-load power requirements of the fan (Fig. 9). It was found that the fan would take care of the straw at low rates of speed satisfactorily, but in some cases the volume of air supplied by the cleaning fan was greater than the volume required by the windstacker fan at low speeds and poor cleaning was had as well as "puffing out" around the shoe. Another series of tests was run where the rated speed of the fan was adhered to and the rate of straw varied. Fig. 10 indicates that the amount of straw had but little effect on the power requirements of the blower.

No-Load Division of Power. In general the no-load power requirements of the various machines varied very little. This was especially true with cylinder no-load power requirements. With one excep- *(Continued on page 154)*

Machinery to Control the Field Bindweed

By C. W. Smith[1]

THE FIELD BINDWEED, known by botanists as *Convolvulus arvensis,* is a very serious pest in many parts of the United States. The infested acreage in Nebraska has reached such proportions that it has become alarming to many residents, who are preparing to battle the intruder and are coming to the agricultural engineering department of the University of Nebraska for help on the equipment to be used. Interest in the problem has increased very much in the last year, and in anticipation of a determined effort to combat the pest considerable work was done on the problem during the season of 1934.

Facts concerning the field bindweed which have been known for some time are that it is perennial, and spreads by means of seed, lateral roots, and pieces of roots scattered during cultivation. Its root system is very deep, many instances being known where it has penetrated 20 ft and more below the surface of the ground. These roots are a storehouse for plant food and cannot be easily destroyed by man. The root system has the ability to form buds and start shoots toward the surface from almost any point. When the plant is cut off 4 or 5 in below the surface of the ground, new shoots reach the surface in from five to seven days. It flourishes in dry weather when most vegetation dries up. It matures seed in about a month after the blossom appears and it blooms profusely from June to August and somewhat less thereafter until late in the season. Aside from supplying a little pasture, the plant has no economic value. It increases considerably the amount of the cultivation necessary to raise a crop, it may lessen yields from 20 to 50 per cent, and in dry years the reduction may be 100 per cent. The seeds may be carried from one farm to another by bundle wagons, threshing machines, seed grain, manure, hay, and straw. The value of a farm is decreased very materially by a bad infestation of bindweed and loans are hard to secure on such farms. This is sufficient to show the seriousness of the problem, and, while there are valuable data on record relative to habits of the plant, that phase of the subject is being passed over.

While many methods for eradicating field bindweed have been suggested, the agronomy department of the Nebraska College of Agriculture has concluded after much experimental work that there are practically only two methods worthy of consideration, namely, chemical treatment and clean tillage. Although there are some mechanical problems involved in treating with chemicals, it is not the purpose of this article to discuss that phase of the subject. It is quite generally agreed that the use of the chemical (sodium chlorate, the usually accepted one) may be the proper procedure for fence rows, roadsides, and small patches, but that clean tillage is the most practical way to tackle a considerable acreage. That being the case, the immediate problem is to find the equipment to do the work most efficiently. And it is necessary to do it efficiently because no plants can be skipped and make the work successful, and cultivation must be kept up for at least the better part of the two seasons. Clean tillage aims to starve the root system by preventing any growth from taking place above the surface of the ground. There is some question just how often it is necessary to cultivate. In keeping all vegetative growth down on one field last season, one-half was covered twenty-one and the other half twenty-two times from June 13 until the last of October. This may have been more times than was absolutely necessary, but at least fifteen or sixteen times the first season will be required.

Some of the requisites of a machine to do this work would seem to be the ability to cut without skipping or missing a single plant, cut as deeply as practicable, do a

[1]Professor of agricultural engineering, University of Nebraska. Mem. ASAE.

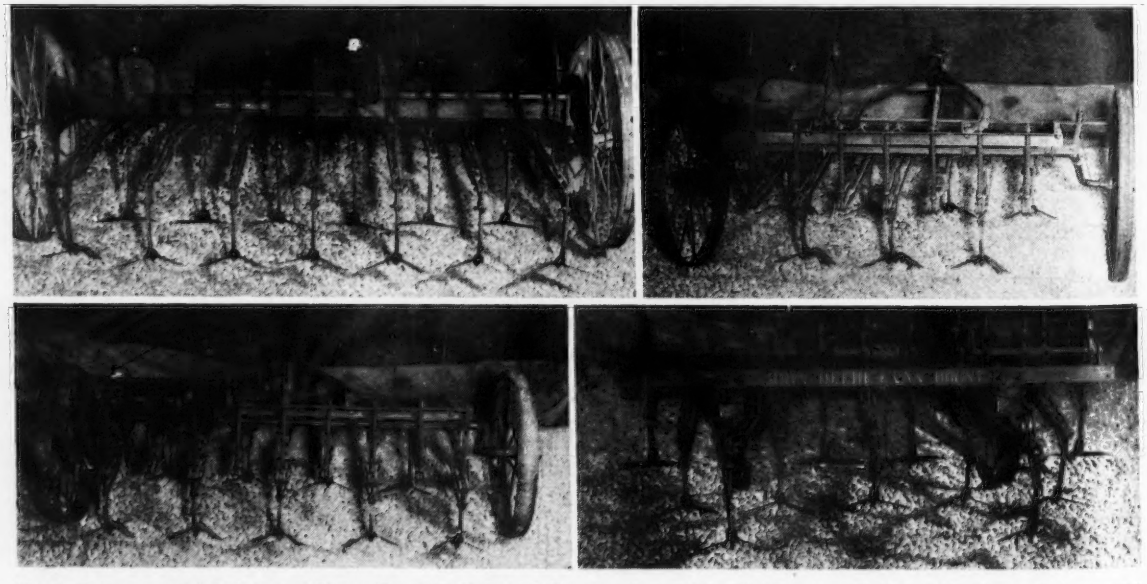


Fig. 1 Four commercial duck-foot machines: (Top, left) McCormick-Deering; (top, right) Allis-Chalmers; (bottom, left) Oliver; (bottom, right) John Deere Van Brunt

minimum amount of stirring the soil, leaving it in the best shape to withstand both washing and blowing.

What machinery should be used? The job is one which not only produces no immediate income but requires a considerable outlay at least in power and time. Most machinery companies have a machine listed under some such heading as "field cultivator," "fallovator," "culti-field," or "field tiller" which can be equipped with duck-foot shovels or sweeps. Fig. 1 shows four such machines. Some have found these machines satisfactory for their work. All conventional duck-foot machines gave some trouble in scouring this past season in the fields being worked by the University of Nebraska agricultural engineering department. Assuming that they are perfectly satisfactory, it means an additional farm machine that can be used for little besides the summer fallowing in a region where summer fallowing is not otherwise practiced. Fig. 2 shows the general arrangement of the duck-feet on such machines and also one pull duck-foot used on machines described further on in this paper. The overlap should be large to make certain that no weeds slip around and between the shovels. A duck-foot of the type used on these machines is called a push duck-foot.

Most farmers show by their questions and suggestions that they would be very happy if they could use some machine they already own to fight the bindweed. With this thought in mind two conventional farm machines were used as bases on which to mount devices for bindweed eradication. The first was a two-row, tractor-drawn lister. It is shown in Fig. 3 and was called the V-blade lister machine. The large V-blade had several advantages: It would not skip any plants, it worked the soil a minimum amount, and was not expensive if the two-row lister was available. At times it was necessary to weight it to keep it in the ground and level, but on the whole it was very successful. It was used a considerable part of the season.

A second attempt to convert a conventional farm machine to this purpose was made with a two-bottom tractor plow. This machine, Fig. 4, was not completed until the first of January 1935, and has only recently been given a brief trial. While it may need minor changes, there is no reason why it can not be made to work, but, since it required more blacksmith work and time than any other job undertaken, it is considered somewhat impractical for most situations. A farmer had two discarded tractor plows and was anxious to have them used as an experiment, and the results would seem to indicate that the average farmer should not attempt to make a bindweed machine out of a moldboard plow. Any plow without remodeling may be used for bindweed. But a plow is too slow, stirs the ground too much for continuous summer fallow, and very likely could not be made to scour after two or three times over a field. A study of Fig. 4 will show that the rear furrow wheel had to be replaced by a larger wheel, one to run vertical instead of tilted, and the linkage on the lift had to be enlarged. A large part of the right-hand side of the plow had to be rebuilt to make room for a third beam. The large V-blade which it carries is much like that used on the V-blade lister.

Another point of attack is to build a machine from the ground up. This procedure was followed and two machines built. The first, Fig. 5, is called the A-frame machine. It uses a so-called pull duck-foot. One such duck-foot is

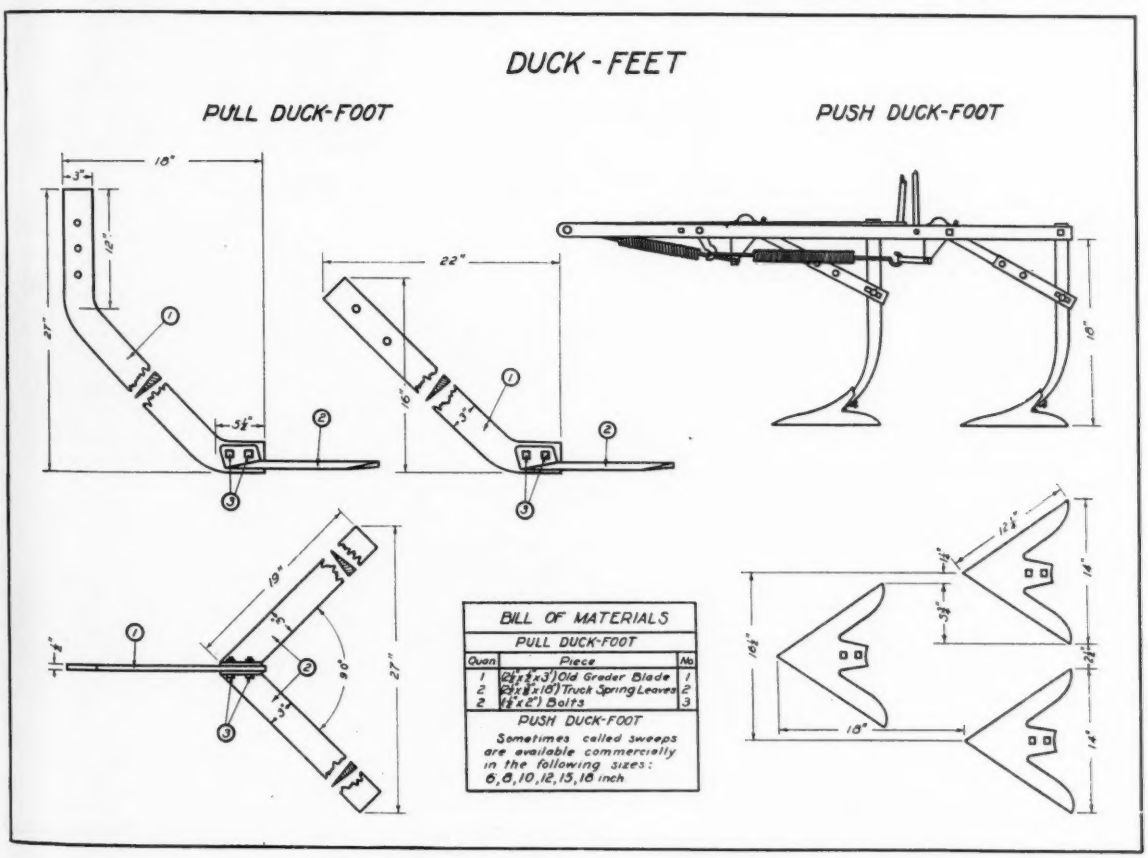
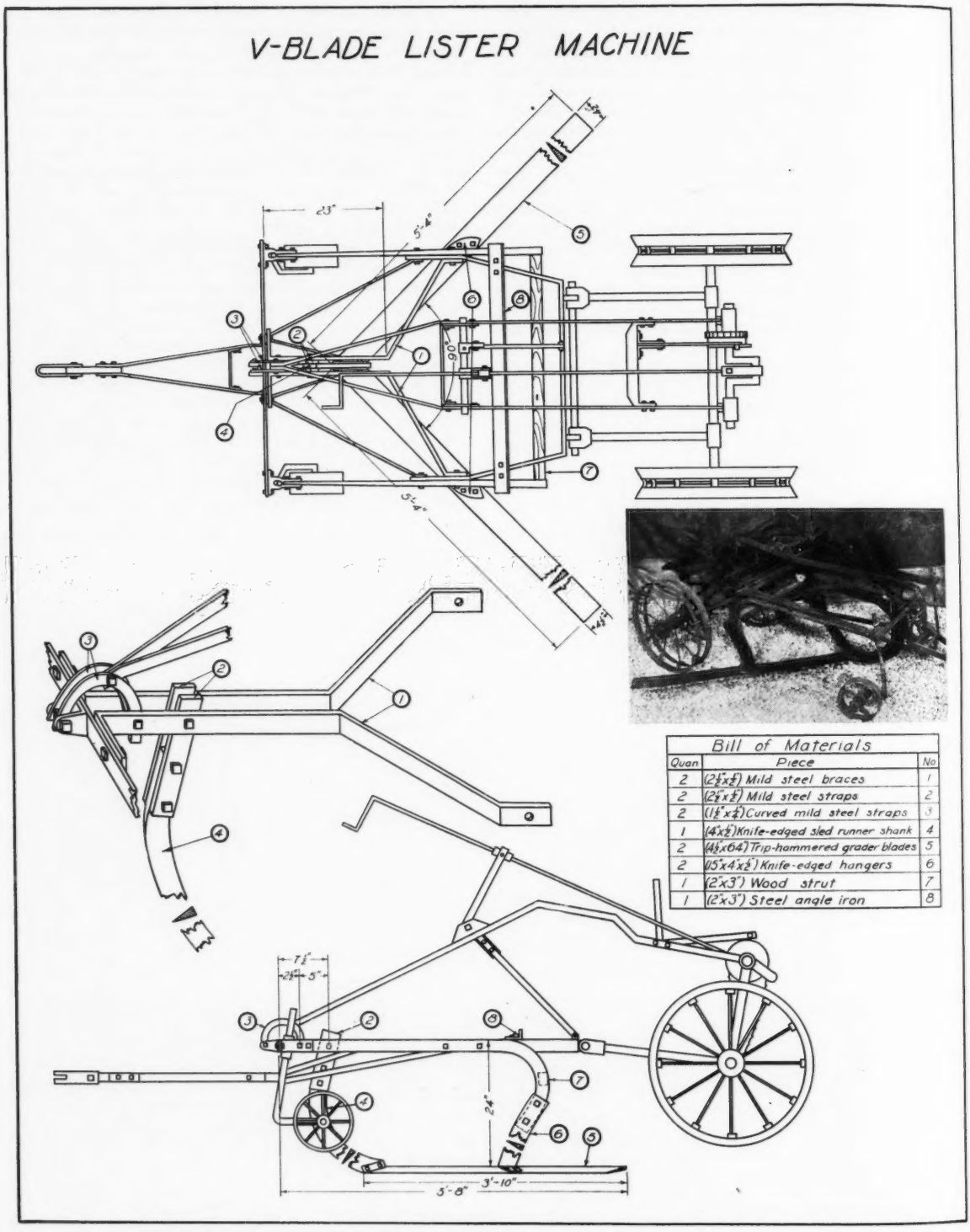


Fig. 2 Details of one pull duck-foot and several push duck-feet

shown in detail in Fig. 2. These duck-feet were made in our shop and were of two slightly different types, one having an angle of 90 deg and the other 120 deg. The 90-deg type is considered the better. The shank pulls the duck-foot rather than pushes it. The front edge of the shank is sharp and, having a sled-runner shape, cuts through and clears trash, roots, and stems. These features were very satisfactory. This same feature had been used

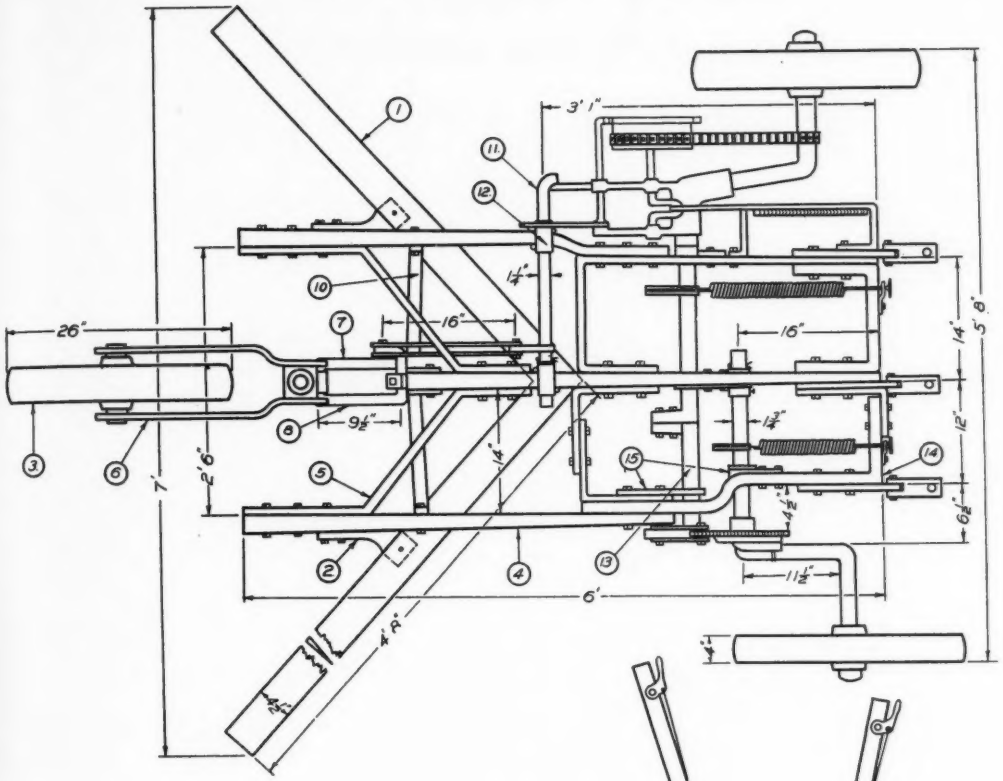


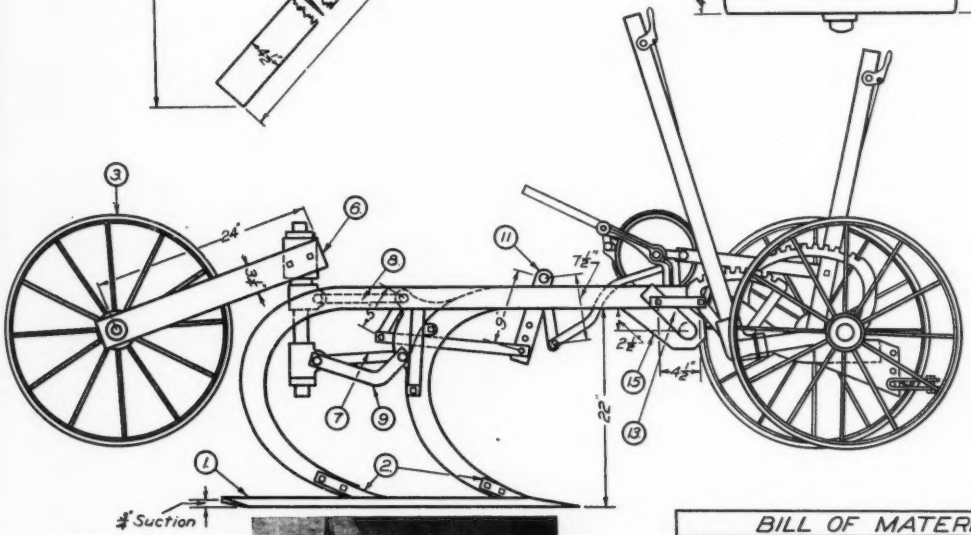
Bill of Materials

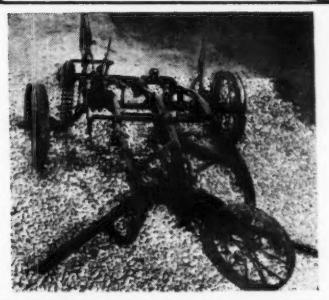
Quan	Piece	No
2	(2½"x½") Mild steel braces	1
2	(2½"x½") Mild steel straps	2
2	(1½"x½") Curved mild steel straps	3
1	(4"x2") Knife-edged sled runner shank	4
2	(4½"x64") Trip-hammered grader blades	5
2	(15"x4"x2") Knife-edged hangers	6
1	(2"x3") Wood strut	7
1	(2"x3") Steel angle iron	8

Fig. 3 The V-blade lister machine made by suspending a large V-blade below a Chase two-row tractor lister

V-BLADE PLOW MACHINE







BILL OF MATERIAL

No.	Quan	Piece
1	2	Trip Hammered Grader Blades 4½" × 4' 8"
2	3	Blade Hanger ⅜" × 1½" Iron
3	1	Plow Wheel 26" Dia
4	1	Extra Plow Beam
5	1	"I" Brace. 1¼" × 2½"
6	2	Mild Steel Straps. ⅜" × 3¼"
7	1	Link 1¼" Dia.
8	1	Bent Link 1¼" Dia
9	1	Bent Strap. ⅜" × 2" Iron.
10	2	Brace ⅜" × 1½"
11	1	Cross Shaft 1¼" Dia
12	2	Pipe Sleeve 1¼"
13	1	Axle Extension. 1½" Dia.
14	1	"I" Frame Member 1¼" × 2½"
15	2	Mild Steel Axle Supports. ⅜"

Fig. 4 The V-blade plow machine made by combining parts of two tractor plows and hanging a large V-blade on the lower points of the beams. It involves too much work to be recommended

in making the large V-blade for the lister, but was not used on the V-blade for the plow. All large V-blades, and shanks for both large and small ones, were made from old grader blades. All wings for the small V-blades, or pull duck-feet, were made from truck spring leaves. The A-frame machine has an open box incorporated in its frame for the

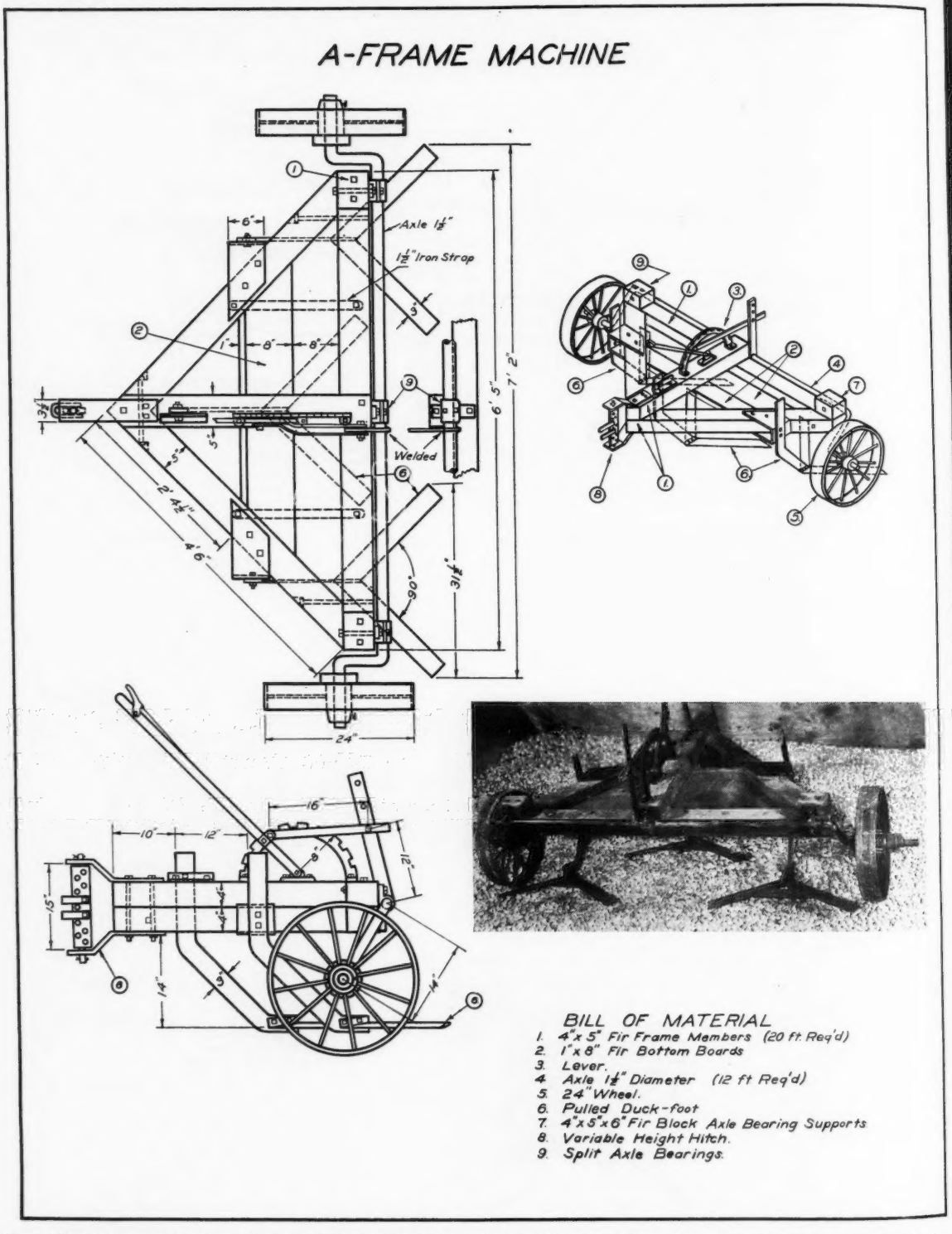


Fig. 5 The A-frame machine carrying three pull duck-feet designed for a tractor hitch. The addition of two-wheel truck in front would make it possible to handle it with horses

purpose of adding weight, either dirt or stones. Practically all bindweed machines have to be weighted at times.

While the A-frame machine was relatively simple and inexpensive, an effort was made to build something even cheaper. This resulted in the grasshopper sled shown in Fig. 6. It carries three pull duck-feet and a simple box or

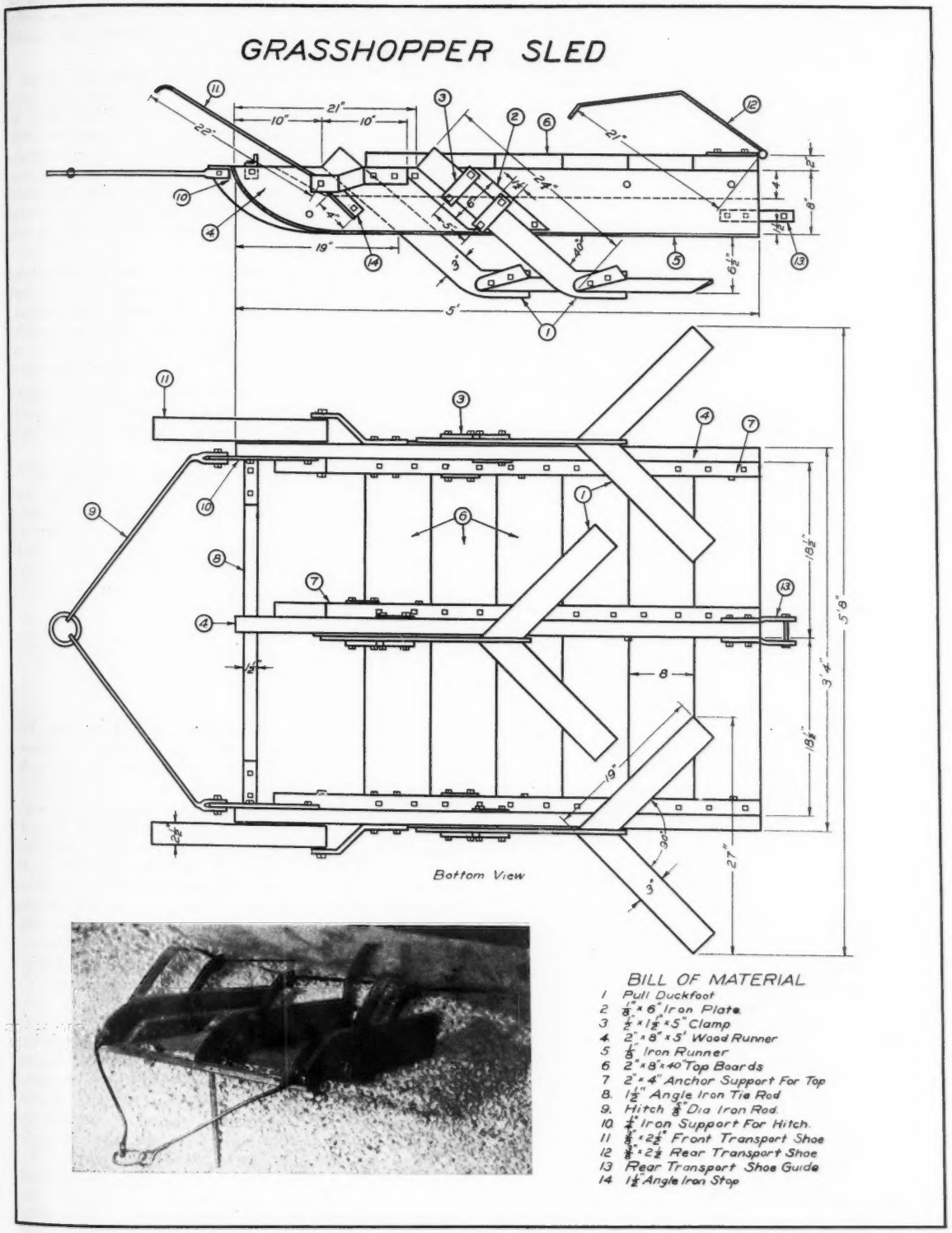

GRASSHOPPER SLED
Bottom View
BILL OF MATERIAL
1 Pull Duckfoot
2 1/8" x 6" Iron Plate
3 1/2" x 1 1/2" x 5" Clamp
4 2" x 8" x 5' Wood Runner
5 1/8" Iron Runner
6 2" x 8" x 40" Top Boards
7 2" x 4" Anchor Support For Top
8 1 1/2" Angle Iron Tie Rod
9 Hitch 5/8" Dia Iron Rod
10 1/4" Iron Support For Hitch
11 3/8" x 2 1/2" Front Transport Shoe
12 3/8" x 2 1/2" Rear Transport Shoe
13 Rear Transport Shoe Guide
14 1 1/2" Angle Iron Stop

Fig. 6 The grasshopper sled which was designed with the idea of making one cheaply. It is not as satisfactory as a machine on wheels

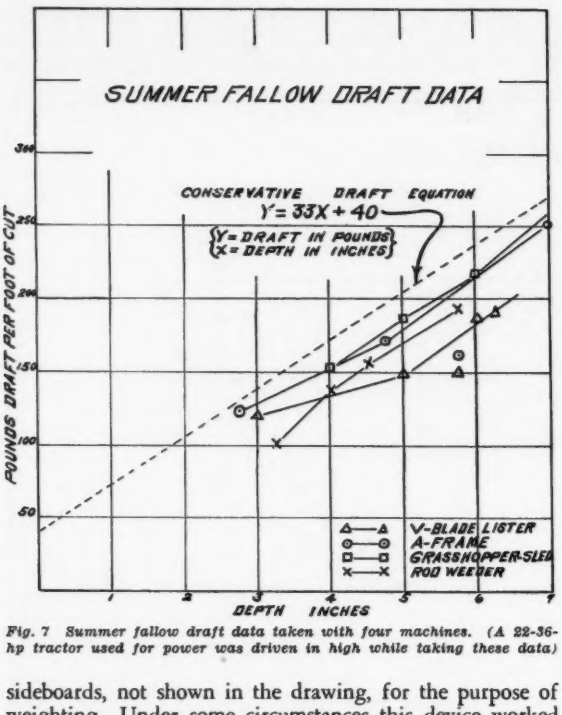


Fig. 7 Summer fallow draft data taken with four machines. (A 22-36-hp tractor used for power was driven in high while taking these data)

sideboards, not shown in the drawing, for the purpose of weighting. Under some circumstances this device worked well, but, generally speaking, it was not so satisfactory. It was harder to hold level without excessive weight. Its draft, per foot of cut, was the highest of any tool tested. It might serve for someone who had only a small patch, but for a considerable acreage a machine on wheels is needed.

The rod weeder was used some. Where a field was being cultivated for the first time and the ground was covered with vines and full of roots, the rod weeder proved to be one of the best machines for getting the field in shape for fallowing. It did not prove to be so successful for the follow-up work because all plants were not cut off and covered to a uniform depth.

The Killefer, or panbreaker, was used some to get a much greater depth than was possible with the other machines, but sufficient power is not usually available to handle it unless the work becomes that for a contractor. The deeper the plant is cut off, the fewer the cultivations required. It takes new shoots longer to come to the surface from the undisturbed root system, and also since the stored plant food is greatest in portions of the root system near the surface and diminishes with depth, the deep tillage does more injury to the weed.

Fig. 7 shows graphs for some draft data taken and also an attempt to write a conservative equation for the draft per foot of cut for this bindweed summer fallow work. Knowing the power available, the width of cut can be calculated and a machine of the proper width chosen. A 22-36-hp tractor driven in high was used for taking the draft data.

There are possibilities of adapting cultivator equipment and other machines to this work as indicated by reports from several sources. Work along this line will be done this coming season.

The bindweed pest may be so well intrenched that its eradication will become a contract job; something over and above what the average farmer can be called upon to equip for and do. However, the problem is demanding attention now. This paper has been presented with the hope that it may carry some suggestions to others facing the bindweed problem and that they, in turn, may be encouraged to contribute the results of their own efforts.

Engineering in Pest Control

IN ITS ISSUE of September 1934, the "Implement and Machinery Review" of London, England, cites for editorial emphasis from an investigation at the South-Eastern Agricultural College at Wye that "it is now necessary that engineers should keep pace with other scientific advances for the control of pests, and devise means of applying chemicals in an efficient way or on a large scale." This provokes some reflections, among which is the asserted fact that the spray-residue problem, as we know it today, had its origin in the imposition by the British of an arsenic limit for apples.

A review of these pages through recent years is evidence enough of the increasing attention being given by American agricultural engineers to the engineering phases of spraying. More significant is the formation in the American Society of Agricultural Engineers of a technical committee on pest control. This committee has a peculiarly difficult task in that its subject matter is hard to classify, ramifying through several of the major technical divisions. This committee has shown vision in refusing to limit its subject matter to application of sprays or kindred chemical agents; instead it has broadened its approach to embrace every plausible form of physical influence.

In the present state of knowledge many of these proposals seem far-fetched. Yet electrocution of the codling moth for example, has reached a degree of effectiveness and economy that is competitive with the old and presumably perfected processes of poisoning with arsenicals. The possibilities of electrostatic attraction, diathermic destruction, and other seemingly weird phenomena are not to be dismissed, but developed.

Heat, too, is an agent in pest control which the committee deems worthy of serious study. Although a costly agent as then applied, its part in meeting the corn-borer invasion at its acute peak left lessons which should not be forgotten. Indeed, the fact that all of the effective effort in combatting the corn borer at that stage was engineering in character should be a source of abiding inspiration. That "learning to live with the corn-borer" took the form of simple mechanical expedients shows that the possibilities, and especially the economics, of mechanical methods deserve further study.

The use of chemical poisons is no longer the single problem of application. Their removal has become another problem, and one that promises to become more exacting as time goes on. So long as these processes seem necessary, the engineer will do his best to make them efficient. Indeed, only efficiency in the engineered phases can combat the increasing costs of more frequent and more thorough applications as apparently are needed. But if the law of diminishing returns is to be avoided, it seems likely that we shall have to shift, at least in part, to physical agencies. The engineering of pest control deserves emphasis from every branch of the profession.

Portable Elevator as a Labor-Saving Device on the Dairy Farm[1]

By F. W. Atkeson[2] and Hobart Beresford[3]

ELEVATION of baled hay, baled straw, and sacked grain or other concentrate feeds into the haymow or second-story storage room of the barn is a problem on thousands of dairy farms. Feed required per animal unit during winter months necessitates large feed-storage space in relation to the first-story space used for stabling the cattle. The majority of dairy barns are two-story structures with large storage capacity in the second story. Economy in construction undoubtedly is one reason for so many two-story barns, but probably the chief reason is convenience in feeding. Having all the feed and bedding stored above the cattle so it can be shoved down chutes to the first floor minimizes the labor of feeding and bedding the cattle during the long winter months, especially in areas having heavy precipitation in the winter. While not claiming originality for the system herein described, the authors do wish to emphasize the importance of the problem generally, and to discuss the economy and adaptability of a mechanical elevator in piling sacked grain and baled hay or straw.

Evidences of the elevation problem are the hundreds of bank barns built, so it is possible to haul wagonloads of feed directly into the second story. The topography of the building site, however, often precludes the construction of this type of barn in many sections. Such barns are also wasteful of more space, as a wide alleyway the width of the barn cannot be used for storage because it must be kept open as a driveway. Some idea may be obtained of the space wasted in order to have this convenience in feed elevation by the following example: If a mow measuring 36x72 ft was divided in the middle by a driveway 10 ft wide, the usable storage space would be reduced by about 14 per cent.

Construction costs, under most conditions, would make the bank or second story drive-in type of barn an expensive type of feed elevation.

In the standard two-story barn feed is hoisted or pulled up in some improvised manner by the use of pulleys or cumbersome slides. Elevating large quantities of feed a sack or bale at a time not only is a slow, laborious task, but requires the time of several men and a horse. The problem of elevating loose hay usually is solved in a satisfactory manner, but the number of dairymen the country over using baled hay have need of a better system of feed elevation. Also, the winter supply of straw must be elevated in baled form because convenience in handling and cost of storage space do not justify, in most cases, the storage of loose straw in the mow.

Even in hay sheds some elevating device is needed if baled hay and straw are stored. The hay and straw storage sections usually are constructed quite high for economy in storage, and feeding sheds may be attached for convenience in feeding and bedding the cattle. Baled hay and straw are stacked on the ground or floor, but the height of the pile soon creates an elevating problem almost as serious as in the case of second-story mows.

In the system of stabling used at the University of Idaho dairy barns, elevating problems typical of all three types of barns are involved. The milking barn is a two-story bank barn with a story and a half wing attached. The inside dimensions of the box stall section are 64 by 47 ft. This wing of the barn has a standard gambrel type roof. Due to the width of the barn the height from the mow floor to the ridge pole is 34 ft. The usable cubic space of the mow is 64,000 ft. The load limit of the floor will allow baled hay to be piled an average of 20 ft high, or 13 bales high, with safety, making a cubic hay storage space of 51,000 ft. The driveway enters the mow on the side of the barn about the center. If this driveway, which is 10 ft wide, is kept entirely open, 15.6 per cent of the cubical area of the mow and likewise of the hay storage space is wasted. After both sides of the mow are filled, however, the back half of the driveway is filled, making a loss of hay storage space of 8.3 per cent. Even with the driveway, the height and width of the pile makes the use of a horse and block-and-tackle economical in elevating about half the hay stored.

Hay or straw stored in the story and half wing of the barn must be elevated 11 ft from the ground to the mow, typical of most standard two-story barns. Adjacent to the barn is a storage shed for hay and straw. Attached to each side of the storage shed is a loafing shed where most of the herd is kept except at milking time. The inside dimensions of the center section are 83 by 29 ft, and 27 ft from the ground to the ridge pole. The usable cubic space represented is 48,180 ft, and the shed has a capacity for about 600 tons of baled hay and straw. Hay is piled 20 ft, or 13 bales high. Due to the length of the barn the hay must be dragged a maximum of 40 ft even when filled from both ends. Dragging the hay back is no small part of the task of piling.

Not only was some system of elevation needed for the mow of the story and a half barn, but the height the hay was piled in the other two barns made it just as essential for them. For several years a horse and block-and-tackle were used. Each bale was elevated by driving the horse forward a short distance and then backing him up. Monotonous backing all day represents almost inhumane type of work for the horse. Slides were provided to carry the hay part way to the back of the pile by keeping the face of the pile two bales higher upon which 2-in planks were laid. Besides the horse, five men were required, one to drive the horse, one to hook bales and keep tackle straight, one at the top of the pile to receive the bales and start them down the slide, and two men to drag back and pile. Each bale, one after another, required each of these operations all day long. Of course, when the piles were low less labor was required, but in general such a crew was needed. From 20 to 25 tons of hay handled in this manner was a good day's work in eight hours. At $2.00 per day for man labor and the same for horse labor, the cost was about 50 cents per ton for piling. Not only was it slow work under this system, but with several trucks hauling, hay piled up on

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[1]Approved by the Director of the Idaho Agricultural Experiment Station as Research Paper No. 133, and released for first publication in AGRICULTURAL ENGINEERING.

[2]Head, dairy husbandry department, Idaho Agricultural Experiment Station.

[3]Head, agricultural engineering department, Idaho Agricultural Experiment Station. Mem. ASAE.

the crew so fast there was danger of the hay getting wet before storage. Piling 300 tons of hay and 150 tons of straw each year in this fashion was a long drawn-out process. Although some farmers might think that the job could be done with a smaller crew, nevertheless, when fewer men were tried, the work slowed up so much more that it was not practical.

How to improve the elevating facilities in three different types of dairy barns at the University of Idaho in three different locations was the problem we faced. If equipment already on the market could be adapted to the various conditions, using such equipment rather than developing special equipment has obvious advantages. Portable elevators used in grain warehouses for piling sacked grain seemed to meet all requirements of an all-purpose portable farm elevator.

The elevator purchased was a standard model of the Colfax all-steel portable elevator with a conveyor 24 ft long and 24 in wide. The highest elevation possible is 18 ft and 6 in, and the lowest elevation possible is 9 ft. About three inches from the outer edges of the conveyor are flat linked conveyor chains. Attached on the outer side of the chains are square steel axles spaced about 18 in apart. On both ends of each axle are 3-in wheels which run on a steel track. The axles act as catches for bales or bags placed on the carrier for elevation. Baled straw and hay must be placed on the carrier edgewise in order to fit the 24-in width. The conveyor can be stopped at any time and will hold position when loaded without locking. Power for operating the elevator may be furnished by a gas engine or electric motor. A 1½-hp motor should furnish ample power but a 3-hp motor was used at the University of Idaho because the motor was already on hand.

At the upper end of the conveyor there is a wooden roller which helps to make the bale or bag leave the conveyor as it breaks over the top.

Either hand operated or electric hoists for raising or lowering the conveyor may be obtained, but the latter are more expensive and not essential for uses around a dairy barn, as frequent changes in height are not necessary. On the elevator purchased, special steel brackets were placed on the upper end of the conveyor so that a wooden chute could be easily connected.

When the elevator was "set" for hay or straw piling the face of the pile was kept 2 or 3 bales higher than the rest of the pile, with the chute resting on the front bales. The chute was made of two-inch planks a little wider than a bale wide, an 8-in guide rail on each side. At the end of the chute more planks were placed lengthwise. These planks soon became smooth, and the drop of 3 or 4 ft down the chute carries the bale 20 to 25 ft back in the barn, and each bale is skidded back by hand on more planks as needed. By this arrangement a man is not needed to receive the bales at the face of the pile.

The elevator is moved from one barn to another by hitching a horse to it. It was soon found that the wheels under the conveyor end were too light weight to stand the load. Larger wheels were installed which also made the elevator easier to haul over rough ground. The wheels which came on the elevator would be satisfactory on warehouse floors and other relatively smooth surfaces but not on graveled or dirt surfaces.

The portable elevator has been used three years and has proven satisfactory in every way. Hay, straw, and grain piling has been done much more expeditiously with less labor and better spirit among the crew. When a large tonnage of baled hay or straw is to be piled a "set" for the piler is arranged by building a platform of baled hay or straw crosspiled two bales high. The piler is then lifted on to this platform so that the wheels are clear, the piler resting solidly on the frame. Four men can lift the piler on to the frame, one end at a time. A platform two bales high is about right for easy unloading from a wagon or truck. The wagon or truck load of hay is driven close alongside the platform, and bales can be placed onto the carrier of the piler directly from the load just as easily and almost as fast as pushing the bales off onto the ground. The piler will handle the hay as fast as two men will ordinarily work in unloading. When the unloading is completed, all the hay is on the pile in the barn and the truck is clear to be driven off. No time is lost in dragging bales from under the truck as frequently is the case where hay is pushed off the truck onto a disorganized pile. There is never any of the extra work of dragging bales from 10 to 20 ft to the barn door caused by the crew getting behind in handling the hay and the mixed-up pile getting scattered as it accumulates.

Several checks were made on the rate of handling hay under this system. While in continuous operation, the hay was handled at the rate of 5 bales per minute, or 300 bales per hour. This is at the rate of 18 to 20 tons per hour. Delays between loads and interruptions of various kinds prevent maintenance of this rate through the entire day. Unloading was done without any attempt to hurry, the piler was running at normal speed, and only two bales were kept on the elevator at one time. A service recorder showed that in piling straw 5 loads, totaling 180 bales, were handled in 1 h and 3 min when the lift was 18 ft. This was at the rate of 171 bales per hour, or about 10 tons, including interruptions between loads.

Only 3 men are required to handle the hay as compared with 5 men and a horse by the former system, previously discussed. The man driving the horse, the man hooking bales, and the man receiving bales at the top of the pile are all eliminated, leaving 3 men instead of two for piling. The electric energy consumed in elevating the ten tons was 252 kwh (kilowatt-hours), or at the rate of 0.252 kwh per ton. At 3 cents per kilowatt-hour the cost of electric energy was 7.2 cents per hour and 0.73 cent per ton. In an 8-hour day electric energy cost would average between 55 and 65 cents. Figuring the time of each *(Continued on page 154)*

Portable elevator being used at the University of Idaho dairy barn for elevating baled hay into a large hay storage shed. Note that the elevator was resting on the ground when the picture was taken, and not on the baled-hay platform as recommended

Refinancing of Drainage, Levee, and Irrigation Districts[1]

By Emil Schram[2]

THE DRAINAGE, Levee, and Irrigation Division of the Reconstruction Finance Corporation was organized during the summer of 1933 under the provisions of section 36, part 4, of the Emergency Farm Mortgage Act of 1933, as amended, which authorized and empowered the Corporation to make loans in an aggregate amount not exceeding $50,000,000.00 to refinance drainage, levee, irrigation, and similar districts, generally referred to as agricultural improvement districts. There has been pending in Congress amendatory legislation increasing the total amount available for such loans from $50,000,000.00 to $125,000,000.00 and extending the benefits of the Act to mutual or cooperative non-profit irrigation companies and incorporated water users' associations, and I am happy to report that the amendments were passed by Congress a few days ago.

Under the terms of the Emergency Farm Mortgage Act, all loans authorized by the Corporation must be fully and adequately secured, and the districts when thus refinanced must be economically sound. This is accomplished through strict compliance with the provisions of the Act that we shall have applicant districts appraised and that loans shall be made only where there will be a substantial reduction in the outstanding indebtedness.

This refinancing of agricultural improvement districts is a new governmental activity. Heretofore, refinancing was limited to issuing refunding bonds, which were exchanged through bond houses or underwriters for existing bonds. In such cases the districts themselves revamped their financial structures by postponing maturities and/or reducing the rate of interest. But, so far as I am informed, our division is the first governmental agency set up to purchase refunding bonds of eligible districts, thereby enabling them to pay cash for their outstanding obligations.

Refinancing Plan Eminently Fair to All Concerned

As a rule, the federal government has no financial interest whatever in the districts themselves, our duty being to take the facts and circumstances existing in each case, such as the amount of cultivated and unimproved lands, the probable income therefrom, the outstanding indebtedness, present market value of the bonds, and by this yardstick, or yardsticks, determine the reduction that should be effected to render the project economically sound. It is the policy of the Corporation to render assistance to those districts in the greatest distress and where the largest discount in their outstanding bonds can be obtained. If, then, the bondholders are willing to accept the refinancing plan, they will be paid "cash on the barrel-head," as the saying goes, for their bonds.

This plan of refinancing is eminently fair to all concerned, as it not only brings relief to the landowners, but also to the bondholders, and gives them all they can hope to receive from their bonds, and gives it to them in cash. In other words, when the "ability of the land to pay" is determined, that is all the holders of the outstanding bonds can expect to receive, and, also, such amount is all the landowners can be expected to pay. We mean by "ability of the land to pay" what the average landowner in one of these districts can and will pay in the way of taxes and assessments per acre per annum during the period of the loan rather than lose his land. There is no state where any personal or individual liability for district assessments attaches, and the owner of the land can therefore pay them or abandon his land as he sees fit. Manifestly, when these taxes and assessments are too high, the landowner merely holds on hoping against hope that something will happen which will enable him to pay them, and in the meantime he does not maintain the fertility of his land or keep up his improvements, but merely awaits the day when the sheriff or some other officer puts him off through foreclosure proceedings.

It must be apparent that, if we base these loans on any other theory, it might result in the outstanding bondholders getting more than they are really entitled to, and unless the new or refunding bonds represent an amount which the landowners can reasonably pay the loan would not be adequately secured, and sooner or later the district would be in the same distressed condition it was before being refinanced, resulting in a loss to the landowners of their holdings and to the government through default in the payment of the refunding bonds it has purchased.

Money Will Be Repaid Without Expense to Taxpayers

There is one phase of this new form of refinancing that gives us a great deal of satisfaction, in that it brings real, definite, certain, and, above all, equitable relief to all concerned, and at the same time it should not cost the taxpayers of this country one penny. The interest on the refunding bonds will care for the overhead of the government in making and collecting these loans, and since they are based on the ability of the land to pay, the money advanced by the government will be repaid with interest without expense to federal taxpayers.

In short, the funds furnished by the government for this refinancing will be repaid, and therefore the government is merely lending its credit for the relief of an industry which furnishes food and raiment for the people of this country.

There are many reasons for the distress found in these districts. At the time most of them were organized, no one anticipated that the production of farm products would overtake or exceed the demand therefor. Neither was it realized that the time would come when there would be no need for bringing new land into cultivation, whereas today we find the Secretary of Agriculture saying in his public addresses that at least 40,000,000 acres of marginal lands must go out of production. Eminent private authorities increase that amount very materially, some placing it as high as 100,000,000 acres.

As agricultural engineers, you are thoroughly familiar with the causes for the failure of so many drainage and irrigation enterprises. You may be interested, however, in

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[2]Chief, Drainage, Levee, and Irrigation Division, Reconstruction Finance Corporation.

learning that our study of the applications submitted for refunding loans shows the following are the principal reasons for such failures:

1 Overcapitalization, due primarily to the reduction in the price of farm products.

2 Short bond maturities, sometimes necessitated by state laws, resulting in excessive annual charges for the retirement of principal.

3 Poorly conceived enterprises, resulting in excessive costs for construction and operation.

4 Excessive maintenance costs.

5 Excessive or impregnated water, resulting in the deposit of injurious salts or water-logging the land, necessitating the construction of drainage systems, thus adding to the assessments against land already over-burdened in this respect.

6 Insufficient water supply, with relation to the cost of construction.

7 Unscrupulous or inefficient engineering, legal, or financial advice, resulting in insufficient installations or in greater indebtedness than the landowners anticipated or could bear. Incidentally, we have found districts which received as low as 35 cents for their bonds. While, no doubt, the investor paid practically par, it is evident that funds expended for improvements cannot represent more than the amount so received and far less than the face value of the bonds now sought to be refunded.

In many cases, districts now in bad financial condition would never have been organized had they been properly advised, and would now be economically sound if they had been properly handled from the beginning. I have special reference to those drainage and irrigation districts which are forced to pump water against excessively high heads without compensatory low power costs. The returns from farming operations since the installation of these systems have steadily decreased, but the cost of power remains practically stationary.

From this, you can readily see there are many features other than the mere matter of dollars and cents to be considered in refinancing these districts, if they are to be economically sound in the future.

Government Requires Project of District to Be Economically Sound

The attitude of representatives of applicant districts and bondholders is sometimes rather critical of this requirement that the project of the district be economically sound. Some have gone so far as to suggest it is the duty of the government to correct all errors in the construction of the improvements of these districts, as well as their overcapitalization and injudicious financing, by purchasing the bonds at par and then working out their troubles through the media of longer maturities and low rates of interest. Of course, this merely means that the government would set up an agency for the purpose of bailing out a lot of bad investments and worthless bonds. The refinancing of these districts is entirely divorced from any thought of paternalism, and each loan is made with the firm conviction on our part that it will be repaid in full.

The policy of non-payment of taxes in the future is not contemplated, and we make it very clear to applicant districts that they are not merely changing creditors with the expectation that some stroke of good luck will relieve them from paying assessments or that Congress will come to their rescue through the cancellation of their obligations.

As a rule, the presently outstanding bonds, especially of the larger districts, are scattered among many holders over wide areas so there can be little unity in enforcing collections. When refinanced, the bonds will be held by one owner, and it will be a simple matter to enforce collection. And, believe it or not, that will be done. We make this very plain to the officers of applicant districts, and shall undertake to exercise helpful supervision over the activities of those districts which we refinance.

One of the principal criticisms of the Act under which we are functioning is that it encourages applicant districts to repudiate their obligations. The term "repudiation" is anathema to the average person. This cry of repudiation is often used by bondholders' committees and the bondholders themselves.

Of course, there are radicals on each side. Some landowners insist the bonds of the district in which they have holdings are worth nothing, whereas in cases where we know bonds are not worth more than 25 cents on the dollar, individual bondholders insist their bonds are worth par. I am glad to report that as a rule the officers of the districts and many of the landowners therein have insisted that the outstanding bonds were issued in good faith and make it very plain that they do not wish to repudiate and will pay as much as possible. In fact, one of our greatest difficulties has been to protect the districts from themselves in their optimism as to the amount of the refunding bonds they can carry and as to the assessments they will be able to collect in the future for bond service.

The RFC Will Maintain Close Supervision of Borrower Districts

It has been said, and justly so I think, that the average farmer is the most optimistic individual on earth. He overrates the fertility and production of his soil, his own capacity for work, and last but not least with childlike simplicity he hopes to receive for his products an amount far in excess of what he actually does receive. Certainly I can appreciate this attitude, as farming has been my life's work, and it is now less than a year since I left a very fine Illinois farm in a drainage and levee district. In the spring of 1933, with one of the finest prospects for crops that territory ever had, and with a freeboard of some 14 ft above the crest of the flood, our levee crevassed without warning and inundated the district within a few hours, not only destroying our crops but a pumping plant which cost $100,000, leaving the landowners in that district facing what appeared to be an insurmountable loss, and it would have been but for the relief provided by Congress. I am therefore not only speaking to you as the head of the division carrying out the will of Congress, but also as a beneficiary thereunder and without which my life's work bade fair to be a total loss.

Someone has well said that the success of the average agricultural improvement district depends 100 per cent upon intelligent and constructive management. It may be that percentage is high, but too much stress cannot be laid upon management of the affairs of these districts. As I have already stated, with the ownership of the bonds scattered there can be little unity of action on the part of the bondholders, but with the ownership of the refunding bonds in the hands of the Reconstruction Finance Corporation, we will be in a position to, and certainly will, supervise the operation of borrower districts. This will be especially necessary during the first few years after a district is refinanced, and I am glad to say that almost without exception the officers of such districts welcome this supervision, which relieves them from local political and selfish influences. In the past, too few houses underwriting bond issues have aided borrower districts in this respect, and it is my candid opinion that most of the difficulties now confronting these districts could have been avoided if their management had

been more efficient and the proper steps taken to enforce collection of assessments each year, instead of permitting them to accumulate until they became an insurmountable barrier.

This brings me to another question which often confronts us, namely, rehabilitation of the improvements in applicant districts. Under the terms of the Act under which we operate, an applicant district is not eligible for a loan unless it had a completed project at the time of the enactment of the Act devoted chiefly to the improvement of lands for agricultural purposes. This provision absolutely prohibits loans for the purpose of completing new projects or for the extension of old ones, the effect of which would be to bring additional lands into production. There are many districts where the systems of improvements have been constructed for a long time and certain repairs are necessary for proper functioning, and there may be instances in the future where loans have been granted and disasters come to the improvements, as happened in my own district. In such cases repairs or rehabilitation are necessary to render a project economically sound or to protect a loan already granted. The amendment to our Act just passed by Congress empowers us to make such advances, but the authority to make such loans must never be exercised where the primary purpose is to bring new lands into production.

This particular phase of our work should appeal directly to you as agricultural engineers, and, if for no other reason, I am glad of the opportunity to appear before you and outline the character and purpose of this new principle of governmental relief to agriculture.

In addition to the indebtedness of districts as a whole, which we are authorized to refund, there is also the problem of the contract indebtedness on land within these districts as represented by mortgages, deeds of trust, vendors' liens, etc., which are often so large that the landowners' financial problems are not solved by refinancing the districts.

It Is Not the Function of RFC to Refund Private Indebtedness

This has caused the staff of our division much concern, and we have devoted a great deal of time and thought to the question and to the many solutions suggested. Bondholders argue that their claims are secured by assessments which are superior liens to those of mortgages, and they should not be called upon to accept reductions when the holders of junior liens will be permitted to collect their claims in full.

Numerous bondholders have written the President on this subject, in one case pointing out that these contract liens on the lands in a certain district amounted to twice the outstanding bonds of the district. In some districts, where the burden of private liens was excessive, we have even considered making the refinancing of the district conditioned upon a like, or at least a substantial, reduction in the individual liens, but after giving all these suggestions the consideration we accord all important matters, and with the very valuable advice of the directors of the corporation, we have been forced to the conclusion that we could not presume to interfere with private liens on land in applicant districts.

It must be remembered that we are not authorized to refund private indebtedness, that being a function of the Farm Credit Administration and the Federal Land Banks. The idea of composing all the indebtedness within a district as a condition precedent to the closing of our loans is more or less idealistic and would be almost impossible to consummate.

Such a requirement would delay the refinancing of the indebtedness of the district for such a time that the purpose thereof might be defeated.

After all, the refinancing or adjusting of private liens rests with the landowners and the lienholders themselves. If the average landowner can and will pay the taxes or assessments in applicant districts rather than lose his land, the holder of the private or contract lien may be counted on to make the necessary adjustments, rendering it possible for the landowners, through the exercise of industry, initiative, and judgment, to save their property.

We are, however, often able to render valuable assistance to landowners and the holders of individual liens by refinancing a district's indebtedness. In most cases, the Federal Land Banks and other lending agencies prohibit new loans on land within defaulting districts. By placing the districts on a financially sound basis we are thus instrumental in removing this inhibition, and the normal lending of money on real estate security is resumed. The criticism is sometimes made that our refinancing redounds to the benefit of junior lienholders rather than to that of the landowners. This may be true occasionally, but we should not refuse to render all valuable aid, because sometimes the beneficiary may not be the one for whom it was originally intended.

Statistical Data on Applications for Approval of Refunding Loans

At the best, statistics and statistical information are dry subjects, but I would be remiss in my duty unless I gave you very briefly an outline of a few of the facts which have been developed by our division.

Up to and including April 5, 1935*, we had received 798 applications for refunding and rehabilitation loans. Of these, 753 are formal for $148,000,000 to retire a total indebtedness of $285,000,000. Of the formal applications 372 are from irrigation enterprises for over $81,000,000 to retire indebtedness aggregating more than $153,000,000, and 381 from drainage and levee districts for over $66,000,000 to retire an indebtedness of $130,500,000.

To the date mentioned, the board of directors of the Corporation had approved loans for over $52,000,000 to 162 irrigation enterprises, having an outstanding indebtedness of nearly $117,000,000. In these, 2,577,000 acres were involved, having an average indebtedness of $45.24 per acre. When refinanced, this indebtedness will be reduced to $20.10 per acre. Loans for $31,000,000 had also been authorized to 281 drainage and levee districts with an outstanding indebtedness of some $84,700,000. There are over 7,000,000 acres in these districts with an outstanding average indebtedness of $11.06 per acre, which will be reduced to $4.06 per acre when the loans are consummated.

Of course, the above averages—like all averages—do not tell the whole story. The average reduction of indebtedness through the loans granted to drainage and levee districts amounts to 64 per cent, whereas the average reduction for irrigation districts amounts to 57 per cent. Disbursements to April 5, 1935, on account of these loans were in excess of $21,500,000, and as the ground-work has been laid, a large increase in disbursements may be expected in the near future, especially since pending legislation, which I shall more fully mention later, has been enacted.

In connection with this refinancing, there is an important matter I must not overlook, and that is the Act requires us to take into consideration the market price of the outstanding bonds of applicant districts over the six months'

*Since this paper was presented, these statistics have been revised as of this date.—Editor.

period ending March 1, 1933. Very few, if any, of these bonds are listed securities. The market value therefore must be determined from the sales, if any, within the period mentioned. I was somewhat surprised to find that notwithstanding the distressed conditions in most of these districts and the fact that the bonds were in default, there were some sales of bonds of nearly all the districts, more in some and less in others. Some of these were what are commonly called distress sales, being bonds held by defunct banks or by individuals in dire need of funds. The bulk of these sales were over-the-counter transactions. In practically every case the loans authorized to districts will enable them to purchase their bonds for more than twice the market price thereof when ascertained in this manner. Most agencies making farm loans have the property appraised and do not as a rule lend to exceed 50 per cent of the appraised value. With us, however, when we complete a study of a given district and determine the ability of the land therein to pay taxes and assessments, we will recommend a loan based on the full amount of the ability of the district to pay.

This brings me to the procedure for closing the loans authorized to applicant districts. If I had all day I could only mention the many angles—financial and legal—applicable to this feature of our work. We have accountants and financial advisers who are experts in this work, and we have lawyers with years of experience along these lines, whom are diligently laboring to expedite the closing of loans.

It is believed that new legislation will clarify the working of the statutes under which we are operating and remove many of the causes which now delay the closing of refunding loans and make it possible to attain the desired results more promptly. If any of you gentlemen have had occasion to complain of the time consumed in closing loans, I wish to assure you the cause has been beyond our control, and I trust it will now be eliminated.

The Emergency Farm Mortgage Act requires that all or a major portion of the outstanding indebtedness of applicant districts be available for refinancing before the loans authorized, or any part thereof, may be disbursed. Because of the diversity of conditions and the amount of the outstanding indebtedness in each district, no fixed rule can be laid down as to the amount which must be available for refinancing before disbursements can be made. In many cases, temporary loans are made pending final disbursement and the time when all, or substantially all, of the bonds are impounded. Congress recently passed what is commonly known as the Wilcox Bankruptcy Bill, applicable to districts such as here mentioned. Under this Act, when 30 per cent or more of the creditors of a given district submit to a federal court a petition alleging insolvency of such district, and submitting a plan of refinancing, and when two-thirds or more of the holders of outstanding obligations have indicated their willingness to accept the plan proposed, or as it may be modified by the court, authority is given to the court to require all the indebtedness to be thus refinanced.

This being a new law, there naturally will be some doubt as to its validity until it has been sustained by a test case. Furthermore, the provisions of the law are inoperative after two years have elapsed from its passage and approval.

Many districts where a considerable amount of their bonds are not available for refinancing are contemplating availing themselves of the provisions of this Act.

Our position with respect to such action on the part of the districts is a neutral one. Fortunately, if the plan submitted in any bankruptcy proceeding is in line with our views of what is necessary to refinance the district on a sound basis, we will furnish funds for the necessary refinancing.

I wish to take advantage of this occasion to give credit where credit is due, and mention the element that has contributed more to the success of our division than any other one factor, and that is the whole-hearted cooperation that the directors of the Reconstruction Finance Corporation have unstintedly given us. All the members of the board, and especially Mr. Jesse H. Jones, its efficient chairman, and exponent of rugged individualism, and Senator Henderson, the member directly in charge of our division, have with their broad vision and constructive, sound advice been of inestimable assistance. Of all the benefits which have come to me and my associates in our work, the contact with this body of outstanding businessmen and patriots is the greatest.

Portable Elevator as a Labor-Saving Device

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man at $2.00 per day, the total daily cost was $6.60, including electricity. Eighty tons per day should be handled, but to be conservative 70 tons will be used. At this rate the operating cost per ton for handling baled straw would be 9.4 cents per ton. Assuming an annual depreciation of 10 per cent on the $500.00 investment in piler and electric motor, the depreciation charge per year would be $50.00. Also, assuming that the piler is used only 30 full days per year, the daily depreciation would be $1.67. Adding to this $35.00 per year, or $1.17 per day for interest at 7 per cent on the investment, the total overhead costs per day would be $2.84 per day. These costs plus operating costs ($6.60) would total $9.44 per day, or 12.6 cents per ton of straw elevated and piled as compared with costs by the former method (5 men and a horse) of $12.00 per day, or 50 cents per ton. If 400 tons of baled hay and straw were handled yearly, the saving per ton in elevating and piling would pay for the machine in three years. These figures do not consider the losses from exposure of hay to rain or sun bleaching due to slow handling of the crop, or the convenience of prompt disposal of a big task, thereby releasing labor much needed for other work around a dairy farm.

The system of elevating baled hay or straw and sacked grain herein described is probably as practical as any system previously suggested to the dairy farmer. Although the initial investment may be considered rather large by some farmers, the savings in labor make it a wise investment for dairy farmers milking 40 or more cows, provided baled hay and straw are used. The fact that this elevator is portable makes its application suitable to nearly all conditions and much more useful than built-in elevators.

Power Requirements and Efficiency of Threshing Machines

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tion this was also true for the feeder. The separating devices, however, varied considerably (Fig. 11), the simpler designs of separating mechanisms requiring less power. It was noted that a close relationship existed between the power requirements for no load and threshing load. It did not necessarily mean, however, that the light-running machine functioned with the most efficient shelling and separating units.

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, senior agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

VENTILATION OF POULTRY HOUSES, *E. R. Gross*. New Jersey Stas. Circ. 306 (1934), pp. 4, fig. 1. Practical information is given on the planning and installation of ventilation equipment for poultry houses.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE NEW HAMPSHIRE STATION. New Hampshire Sta. Bul. 280 (1934), pp. 27, 28. The progress results are presented of investigations on electric brooding of chicks, pneumatic tires for tractors, steel tractor wheel equipment, and electric water heating and sterilization.

POTATO GROWING WITH TRACTOR POWER, *A. W. Clyde* and *R. U. Blasingame*. Pennsylvania Sta. Bul. 306 (1934), pp. 18, figs. 14. This bulletin describes in general the research procedure and ultimate results in the development of potato growing with tractor power at the station.

The machinery adaptations are traced in their order, and the field data showing power and labor saving are summarized. Some of the machinery adaptations and mechanical developments to meet special requirements, such as cultivator shovel trips, vine lifters, and the like, are diagrammatically illustrated.

The data presented indicate that satisfactory potato yields can be had with tractor power with a minimum expenditure of power and labor. With tractor power and proper equipment, field operations can be quickly and thoroughly done at the time when they pay best.

Suggested machinery improvements are listed.

REPORT OF THE REINFORCED CONCRETE STRUCTURES COMMITTEE OF THE BUILDING RESEARCH BOARD, *G. Humphreys et al.* London: Dept. Sci. and Indus. Res., 1933, pp. IV + 69, figs. 3. The texts of the report and of the recommended code of practice for designing reinforced concrete are given, together with nine appendixes covering among other things certain standard methods of testing both the steel and aggregates of reinforced concrete.

A SEPTIC TANK FOR FARM HOMES, *H. L. Belton* and *J. P. Fairbank*. Calif. Agr. Col. Ext. Circ. 82 (1933), pp. 20, figs. 17. Practical information is given on the subject together with drawings of equipment. This circular supersedes Circular 270 of the station.

ELECTRIC RANGES, *H. R. Howe*. U. S. Dept. Agr., Bur. Home Econ., 1934, pp. [1] + 12. This mimeographed list of references was compiled to supply those interested in the construction, design, and sale of household electric ranges, with a survey of the English literature on the subject published since 1927.

ELECTRIC RANGES FOR HOUSEHOLD USE. U. S. Dept. Agr., Bur. Home Econ., 1934, pp. 10, figs. 6. This presents in mimeographed form the results of a survey of literature published since 1927 on electric ranges for household use.

SMALL ELECTRIC DRIERS FOR FRUITS AND VEGETABLES. [C.R.E.A.] Natl. Rural Elect. Proj. College Park, Md., Rpt. M-14, Sup., (1934), pp. 2, figs. 2. Practical information is given on the subject in mimeographed form, including service test results on fan-type heating units and data on drier construction.

A PRIMER OF ELECTRICITY AND HEAT, *M. M. Monroe*. Maine Sta., [1934], pp. 17. This mimeographed bulletin is intended to give the purchaser and user of electrical household devices an elementary understanding of the principles of transportation of electrical power and its conversion into heat, and the principles of heat transfer.

POWER ALCOHOL, *F. J. de Villiars*. Jour. So. African Chem. Inst., 17 (1934), no. 1, pp. 24-36. Tests are reported which showed that alcohol fuels are clean burning fuels, showing practically no carbon formation. The fuels do not corrode the engine parts, nor do they cause corrosion of tin-lined fuel tanks. They give higher thermal efficiency, greater power, allow a greater degree of ignition advance, and cause smoother running of the engine. In practice it has been found that the danger of the formation of a two-layered fuel resulting from the absorption of atmospheric moisture is small. Alcohol-gasoline mixtures can be used in the engine as it is equipped today without any alterations having to be made. These blends can stand high compression pressures without knocking.

OIL BURNER HEATING. Dom. Engin. Pubs. (Chicago), 1934, pp. VIII + 174, figs. 74. This handbook gives technical information on the planning and installation of oil heating systems. It contains chapters on how to figure cost of heating with either oil, gas, or coal; analysis of oil fuel for oil burners; how to know if its air supply is correct; rapid method of figuring oil consumption; what makes for efficiency in installations; the relation of an oil burner to a coal-designed boiler; practical methods of testing burner efficiency; a testing problem worked out; how combustion chambers are made; oil burners under gas boilers; underheated rooms; testing the heating plant in moderate weather; a practical example of testing a heating installation; piping for headroom; how to separate steam and water; bleeder connections when the headroom is low; a trouble job is solved; how to clean a boiler; what is the Hartford loop; how to calculate seasonal heating costs; and how to figure radiation without tables.

THE SANITARY DISPOSAL AND AGRICULTURAL UTILIZATION OF HABITATION WASTES BY THE INDORE PROCESS, *F. K. Jackson* and *Y. D. Wad*. Inst. Plant Indus., Indore, Cent. India, Bul. 1 (1934), pp. [1] + 26, figs. 8. The present efficiency of disposal and utilization of habitation wastes in India is discussed, and the essentials of the so-called Indore system are described.

The main features of the Indore process are (1) the immediate treatment of both the refuse and night soil, one after the other, as soon as they arrive at the disposal grounds, the carts being backed to the edge of a trench 2 ft deep and 15 ft broad; (2) the addition of half-rotted compost in small amounts as a starter; (3) lightly spreading by suitable long-handled rakes in thin layers so that they become mixed; (4) a rapid rise of temperature (usually to above 50 deg C and never below 45 deg) which persists up to the third turn and kills the pathogenes and fly larvae; (5) the restoration of air three times by turning with a digging fork to insure steady and intense microbial activity and to kill (by burying in the hot mass) any maggots that may hatch out at the exposed cool edges of the heaps. The periods between turning are short enough to prevent any such larvae developing into flies and to reduce the chances of their crawling out in wet weather to shelter and pupate in the bottom and sides of the trench; and (6) the replenishment of lost moisture by adding water, if needed, at the times of turning.

The advantages of this process have been found to be (1) low capital outlay and operating costs, (2) a net profit from the sale of manure, (3) simple construction of permanent trenches not requiring professional engineering knowledge, (4) economy in disposal ground area, (5) the prevention of offensive odors and fly breeding, (6) the process can be worked in the open without cover in all seasons, even during continuously wet seasons with 47 and 52 in of rain and heavy falls of nearly 6 in in 24 hr, (7) no need of skilled supervision, (8) exceptional cleanliness at the disposal grounds, (9) the short period required for complete decomposition to a rich manure in large quantities, which is safer for crops than ordinary poudrette, (10) the surplus income becomes available for other sanitary measures for improving public health, and (11) it is equally applicable to large or small communities.

An appendix gives technical detail. Notes on the sanitary aspect are also given by J. R. J. Tyrrell and M. A. Nicholson.

THE HOMEMADE FRUIT WASHER, *H. C. McLean*. Peninsula Hort. Soc. [Del.] Trans., 47 (1933), pp. 87-90, figs. 2. In a contribution from the New Jersey Experiment Stations a homemade fruit washer is described and illustrated. The machine consists of a two-compartment tank—one compartment for the acid bath and the other for the fresh-water bath. The fruit is propelled through these tanks by paddle wheels. The mechanism can be driven either by 0.5-hp electric motor, or by a 1.5-hp gasoline engine.

GREENHOUSES, BEDS AND SHELTERS, *G. Billault, R. Richard*, and *H. Nottet*. Quebec Dept. Agr. Bul. 128 (1934), pp. [43], figs. [17]. Greenhouses, beds, and shelters adapted to conditions in Quebec are described and illustrated, together with artificial heating equipment.

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NEWS

Features of 1935 ASAE Annual Meeting

NEVER in the history of the agricultural-engineering profession have developments in one or more of its branches resulted in arousing interest to a higher pitch than is true at present. The gigantic programs of the federal government, either already in operation or certain to be, involve a great deal of an agricultural engineering nature, especially in such activities as soil erosion control, rural electrification, farm housing, and rural rehabilitation. So swiftly have these programs been launched, and on such a tremendous scale to meet emergencies of the situation, as to put all groups responsible for carrying them out to a serious test, a test that puts a severe strain on clear thinking and sound judgment.

It almost goes without saying that the things which will be uppermost in the minds of agricultural engineers who will attend the 29th annual meeting of the American Society of Agricultural Engineers at the University of Georgia at Athens, July 17 to 20 next, will be those which relate directly or indirectly to the government programs. Therefore, in anticipation of this the Meetings Committee is building its program to best meet the desires of agricultural engineers in the light of the unusual responsibilities placed upon them. The two general sessions of the meeting to be held during the forenoons of June 18 and 19, will feature keynote papers or addresses on subjects of unusual and timely interest in agricultural engineering, namely, soil erosion control, rural electrification, farm housing, and farm power and machinery.

In addition to this the chairmen of the ASAE technical divisions are arranging programs for the various group sessions that will feature in more detail the main subjects presented at the general sessions. Due to the rapidly shifting scene in Washington these days and the utter impossibility of knowing what the situation on any major activity sixty or even thirty days hence may be, the Meetings Committee is faced this year with an exceedingly difficult problem in completing its program, especially with respect to its purpose of having the program reflect an up-to-the-minute picture of the status of government activities involving agricultural engineering. Under these conditions, while it will not be possible to consider any program actually final until it is presented at the time of the meeting, a tentative program of the meeting at Athens will be published in AGRICULTURAL ENGINEERING for May, which will give the subject to be featured and list most of the speakers.

While there is every assurance at this time that the program will be outstanding from the standpoint of timeliness, interest, and value of papers presented, entirely aside from this is the need felt by agricultural engineers, more this year than ever before, for getting together and discussing with individuals and groups the many problems confronting the profession and pressing for solution. It is anticipated, therefore, that this need more than anything else will be responsible for a large attendance at the meeting in June. The agricultural engineering profession is being presented with its greatest opportunity, but likewise its greatest responsibility. That will be the great impelling reason for a large influx of agricultural engineers from all points of the compass at Athens, Georgia, June 17 to 20 next.

Second International Congress of Rural Engineering

THE ASAE headquarters office has received invitation to the Second International Congress of Rural Engineering to be held at Madrid, Spain, September 26 through October 3, 1935, under the patronage of the Spanish government. It continues the pattern and is predicated on the success of the first such Congress held at Liege, Belgium, in 1930, under the patronage of the Commission du Genie Rural, whose delegates comprise a permanent committee holding executive meetings annually.

Headed by the Minister of Agriculture, the "committee of honour" comprises an imposing list of officials in government, education, and related associations and institutions. The organizing committee, comparable to our committees on local arrangements, has for its president Juan Diaz Munoz, president of the Agricultural Engineer Association, and as secretary Eladio Aranda Heredia, professor of the College of Agricultural Engineers and secretary of the Spanish representation in the International Commission. To him, presumably, should be addressed all inquiries and correspondence at the Organizing Committee's address, Amadeo Vives, 10 - Madrid (12).

The Congress proper, and the accompanying meetings of the Commission Internationale, will occur during the first three days. Sunday, September 29, is designated for a visit to the capital, and the remaining four days for excursions to Toledo, Cordova, Seville, Granada, Valladolid, Saragossa, Valencia, etc. The technical program will run in four concurrent sections, comparable to the ASAE technical divisions.

Section One will take up units and methods of measuring the characteristics of soils as related to underground drainage and mechanical resistance; formulae, coefficients of rugosity, and graphics for flow of water under uniform conditions in drainage pipes, canalization and uncovered canals; relation between atmospheric precipitation and flow in such structures, methods of measuring discharge, etc.

Section Two will consider stable ventilation methods; modern installation of cow houses, pigsties, stables, poultry houses, and sheepfolds; new agricultural building materials; and colonizing buildings placed under a scheme of improvements.

Section Three is to go into soil tilling; traffic conditions of agricultural vehicles (tractors and hauled units) on roads and fields, rigid and elastic rims; motors and fuels; mechanical means of cattle feeding; rural uses of electricity.

The fourth, or management, section will delve into the influence of building arrangement on rational use of workmanship; methods of organizing work by the task; work by contract; and methods of standardizing agricultural work. Besides ratification by the International Commission these agenda have been approved by the International Federation of Technical Agronomists.

Members of the Congress will include the following classes with corresponding fees: Protecting (sustaining) members, 1000 or more pesetas; official delegates from governments and corporations (societies, etc.) minimum 250 pesetas for five or less delegates; individual members, 50 pesetas. Remittances should go to Mr. Heredia, and papers and communications should be deposited with the Organizing Committee before June first.

The official languages to be used are French and English, but individual communications to the Congress may also be in German, Italian or Spanish; in any case to be accompanied by a summary in French. Such communications should not exceed eight typewritten pages of about 400 words. Presumably these limitations do not apply to duly arranged formal papers. All except adherent (family) members are entitled to such publications as may be issued.

A. Lincoln Fellows Opens Consulting Office

CULMINATING a long and varied career involving mainly irrigation and drainage engineering, or broadly all phases of agricultural hydraulics, but including also administration of mineral resources, A. Lincoln Fellows has recently engaged in consulting practice, specializing in water supply, irrigation, drainage, and related problems, with office at 1669 Broadway, Denver, Colorado.

For the six years prior to his retirement as senior irrigation engineer in the USDA Bureau of Agricultural Engineering, he was, to quote W. W. McLaughlin, chief of the division of irrigation in the Bureau, the "recognized consultant" of that division located during that period at Berkeley, California. Ten preceding years, also with the U. S. Department of Agriculture, he devoted mainly to duties involving the semi-arid territory east of the Continental Divide with headquarters in Denver.

Still earlier he was secretary and general manager of a Denver engineering company, state engineer of North Dakota, deputy state engineer of Colorado, resident hydrographer for the U. S. Geological Survey, and chief engineer and manager of the Montezuma Valley Irrigation Company. A member of the ASAE since 1923, it is hoped that the comparative freedom of consulting practice will enable him to participate more actively in the work of the Land Reclamation Division, and particularly to contribute to its counsels the ripe judgment of his rich experience.

Merger of Soil Erosion Work in USDA

TO UNIFY all soil erosion control activities of the federal government, Secretary of Agriculture Henry A. Wallace on March 27, 1935, issued an order establishing a separate soil erosion unit in the Department of Agriculture. Carrying out the purposes of the Secretary's order, Under Secretary R. G. Tugwell at once undertook the task of consolidating the various departmental units working in this field.

The base of the new organization will be the Soil Erosion Service which has just been transferred to the Department of Agriculture from the U. S. Department of the Interior; this transfer was authorized by the Public Works Board at the request of the President. All investigational, service, and control projects on erosion, heretofore handled by the Bureaus of Chemistry and Soils, Agricultural Engineering, and Plant Industry, and the supervision of CCC erosion-control work now under direction of the Forest Service, will be transferred on April 1 to the new unit. Mr. H. H. Bennett, who has been in charge of the Soil Erosion Service since it was organized, and previously was in charge of soil erosion investigations of the Bureau of Chemistry and Soils, will head the consolidated activities.

Research will continue to be conducted at ten field stations, located in regions of different soil types, into the soil, plant, and engineering aspects of the cause and methods of controlling erosion. Using the facts developed by this research, large-scale demonstrations will be continued in various parts of the country.

The recent dust storms, as well as the severe dust storm of May 1934, forcibly called the attention of city and country people to the seriousness of wind erosion. Water erosion, of course, is much more widespread and destructive because it is a continuous process in many parts of the country.

AEC Washington News-Letter

THE following news items of particular interest to the engineering profession were released on March 15 by Mr. Frederick M. Feiker, executive secretary of American Engineering Council, known to the profession as the "Washington embassy of engineers and engineering":

The plan for public affairs committees of American Engineering Council in each locality may be accelerated in cities having sections of national engineering societies. The sections may appoint representatives on a central committee to handle matters of joint interest.

With so much of engineering interest at stake in the current session of Congress, it seems timely to summarize the policies and methods followed by AEC in legislative matters. The staff has for its guidance:

1 Policies adopted by the Assembly and Administrative Board at annual meetings
2 Advice on new matters from special and standing committees
3 Precedent of several years on matters which do not require new rulings
4 The viewpoint of public interest as a fundamental reason for participating in legislative activities
5 The corollary viewpoint of advancing the economic status of the profession.

The factors of public interest and the status of the profession are closely related in problems constantly arising in connection with the federal program, due to the extraordinary relation of government to business at present. Competent engineers must be employed where engineers belong, if the public interest is to be protected against faulty planning and wasteful execution.

Although the Washington embassy of engineers may not jump into drastically new lines of action in the name of the profession without due consultation and approval, it is not hemmed in by ponderous procedure. The precedent set on past work, recognized as in the interest of the profession, gives sufficient latitude for quick action on immediate, practical steps and leaves only the long-range phases for more deliberate action.

Legislation which AEC follows for engineers includes the following general categories:

1 *Construction.* Federal appropriations and administrative machinery for construction. (The work-relief bill)
2 *Development of Industries.* Amendments to National Industrial Recovery Act, new patent legislation, etc.
3 *Development of Natural Resources.* Bills relating to water power, navigation, land reclamation, soil erosion control, surveys and maps, and similar public activities wherein the engineer serves in the development of our "national plant"
4 *Engineers' Welfare.* General legislation in the field of unemployment insurance, old-age pensions, etc.; bills such as civil service measures, engineers' compensation on federal and relief work, etc., more directly affecting the engineer.

Scores of bills under each of the above headings are under consideration. With its limited staff Council is obliged to concentrate on those of the greatest importance to the profession. Where needed, information and arguments are presented to Congressional committees in open hearings or otherwise. Council fills frequent requests from federal agencies setting up programs along engineering lines, for information as to features of concern to the profession. The Public Affairs Committee and its subcommittees are sent copies on important bills and documents and are kept generally informed. By expanding the scope of this news letter, we hope to give the profession at large an increasingly clear and comprehensive account of the situation.

The survey of the engineering profession at last is about to go forward with upwards of 170,000 names compiled under the direction of the Committee on Engineering and Allied Technical Professions with the assistance of 12 relief workers in New York. The engineering societies cooperated so well that the job was far bigger than the expected list of 100,000. The consequent delay was well worth while in extending the base of the survey. The card file of names has been sent to the Bureau of Labor

(Continued on page 158)

New ASAE Members

Dale L. Bidwell, technical foreman, ECW Camp, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Box 131, Lindale, Tex.

Sidney C. Buckaloo, junior agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Ridgeway, Mo.

Frederick G. Krauss, director, agricultural extension service, University of Hawaii, Honolulu, T.H.

Robert H. Vahrenkamp, planning engineer, ECW Camp, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Box 141, Lindale, Tex.

TRANSFER OF GRADE

Donald Christy, assistant agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Wadesboro, N. C. (Transfer of grade)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the March issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Ralph J. Blair, agricultural engineer, Virginia Electric and Power Company, Norfolk, Va.

Leon H. Cassity, assistant agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Box 134, LeRoy, Ill.

Louis B. Earle, technical foreman, ECW and Soil Erosion Service, U. S. Department of Agriculture. (Mail) Correll Hotel, Mankato, Kans.

George W. Endicott, principal foreman, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Dixon Springs, Ill.

F. L. Gibbs, agricultural engineer, Virginia Electric and Power Company, Richmond, Va.

Monroe A. Hartman, junior agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) 717 N. 5th St., Temple, Texas.

James A. Muncey, acting chief agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) High Point, N. C.

H. R. Murphy, assistant manager, agricultural sales division, Caterpillar Tractor Co., Peoria, Ill. (Mail) 302 Hettinger Place.

William R. Stanley, engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Mankato, Kans.

H. Russell Tribou, junior agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Box 882, High Point, N. C.

Wm. A. Weld, assistant agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Greensboro, N.C.

TRANSFER OF GRADE

Ralph W. Baird, associate agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Box 403, Tyler, Texas. (Junior to Associate Member)

Robert B. Hickok, assistant agricultural engineer, Soil Erosion Service, U. S. Department of Agriculture. (Mail) Zanesville, Ohio. (Junior to Associate Member)

STUDENT ACTIVITIES

Contributed and edited by members of ASAE student branches

Attractions at Athens Meeting

IT IS NONE too early for members of student branches of the American Society of Agricultural Engineers to begin planning for the next Agricultural Engineering Students' Conference to be held in connection with the 29th annual meeting of the American Society of Agricultural Engineers at the University of Georgia, Athens, June 17 to 20. The ASAE Student Branch at the University of Georgia has extended to all agricultural engineering students a cordial invitation to attend the Athens meeting.

Due to the illness of Charles Schlotterbeck, official news dispenser of the AESC, I have been asked to prepare a blurb calling attention to some of the attractions of the meeting that should appeal to agricultural engineering students. So here goes!

Let's make it a big affair. Bigger and better than any student gathering at past ASAE meetings. Just ask the boys who have attended past meetings whether or not they have found it worth while.

A brief resume of the program of the ASAE was published in the March AGRICULTURAL ENGINEERING. Watch the May issue for the program to be presented by the Students' Conference, which will be held on the first day of the meeting, Monday, June 17. We are to have all day for our conference if we want it.

Those who like the out-of-doors may avail themselves of the use of Camp Wilkins on the University campus at the nominal cost of 25 cent per day, but each student must furnish his own blankets. Eats will be served at Dawson Hall Cafeteria on the campus, the cost, of course, depending on your appetite. In this connection, we are informed that the cost of living in the South is cheaper than in the North, and that's something.

No one, of course, really wants to miss this meeting, if it is at all possible for him to attend, especially when he looks over the list of attractions. For example, you will have the pleasure of seeing and hearing a sound picture based on the development and operation of the TVA project. Also an opportunity to dance with southern girls. At the annual dinner of the Society the principal entertainment feature will be the singing of the Big Bethel Choir from Atlanta, consisting of between 200 and 300 people, and perhaps the most famous negro choir in the South.

Then there will be a southern barbecue, which is a particularly famous institution of the South. At that time of year watermelons in southern Georgia will be ripe, and there will be carloads available for the watermelon cutting in connection with the annual meeting. And leave it to the student to find many other attractions which will make the trip worth while!

We are sorry to have to inform Lester Malkerson, president of our AESC, that the season on opossums is closed.

And now let me urge individual students to start planning right away to make this trip, and I would also suggest to student branches that they make a special effort to work out ways and means whereby students can attend in groups and thereby reduce the expense to individuals.

See you all at Athens bright and early Monday, June 17!—Edwin K. Bonner, Jr., special scribe.

Prepare Now for Athens

ACCORDING to Dan Norton, chairman of local arrangements for this year's Agricultural Engineering Students' Conference to be held in connection with the 29th annual meeting of the American Society of Agricultural Engineers at the University of Georgia, Athens, June 17 to 20, the season is at hand for all members of ASAE student branches to start dropping small coins in that little emergency bank on the corner shelf, and just to prove that Dan is up on his toes, he sends word that lodging may be had as cheap as 25 cents per day, a camp having been set aside for this purpose. Also $1.00 a day will cover the cost of meals, which means that with such an opportunity no student branch member can afford to miss the Conference in June.

Anyone desiring more particulars concerning the Students' Conference or details of the local arrangements which are being made, may address Lester Malkerson, agricultural engineering division, University of Minnesota, University Farm, St. Paul.—Charles Schlotterbeck, news chairman.

Missouri Branch Takes Part in Exhibition

THE Missouri Student Branch of the American Society of Agricultural Engineers spent the week of March 21 preparing an exhibit for the Engineers' Industrial Exhibit held March 19, 20, and 21. This exhibit was one of the best industrial shows ever held in Columbia. Some of the leading manufacturers of motor cars, refrigeration units, plumbing equipment, light plants, telephone systems, acetylene welding equipment, stokers, wood-turning tools, heating systems and household equipment had exhibits there. Large crowds were attracted and the exhibit was a success in every way.

The agricultural engineers exhibit consisted of a dynamometer to measure the draft of farm implements. This dynamometer was designed by Mr. G. W. Giles, a graduate student of this branch of ASAE. The dynamometer was connected to a tractor and plow and made a splendid exhibit. In order to impress the spectators with the working principle of this instrument, one of the cylinders was connected to a pressure gauge and arranged so that anyone might test his strength.

At the last regular meeting, April 2, the election of officers for the fall semester of 1935 was held. Mr. Paul Doll was elected president, Robert Beasley vice-president, William Klingner secretary and treasurer, Kenneth Huff sergeant-at-arms, Robert Beasley scribe, and G. W. Giles faculty advisor. —Robert Beasley, scribe.

To the Editor:

A few days ago Mr. Beasley, scribe for the Missouri Student Branch of ASAE, sent in a report of branch activities, and I feel there should be an addition to it on account of the developments since the report was mailed.

This Branch has been responsible for procuring individual prizes for our farm shop contest for vocational agriculture students. This was obtained through the cooperation of the Kansas City Tractor Club which is sponsoring the award. We are using the tokens designed by agricultural engineers at Ohio State University (described in AGRICULTURAL ENGINEERING for December 1934) and are having these made from the mold purchased from them. We are giving one token in solid gold, one in sterling silver, and one in bronze for first, second, and third prizes in the farm shop contest which will be held at our institution about May 1.—J. C. Wooley, professor of agricultural engineering, University of Missouri.

News of VPI Student Branch

A SMOKER held March 14 completed the activities of the Student Branch of ASAE at Virginia Polytechnic Institute for the winter quarter. The program consisted mainly of talks given by members of the branch and others. One of the features of the program was a lecture on Diesel engines presented by a representative of the International Harvester Company. He first discussed Diesel engines in general and then gave a detailed description of the construction and operation of the McCormick-Deering Diesel.

At a previous meeting, February 28, Professor P. B. Potter gave an interesting talk, entitled "The Vastness of Boulder Dam," based on a visit which Prof. Potter made at the dam on a trip to California last summer. "Boulder Dam was the most interesting thing I saw on the entire trip," said Prof. Potter.

The VPI Student Branch will meet on March 28 to discuss plans for the work of the third quarter.—J. L. Calhoun, scribe.

AEC News-Letter

(Continued from page 157)

Statistics, U. S. Department of Labor, and the final questionnaire was approved in a New York meeting, March 4. Now for facts about the status of the profession.

Council's new membership plan has definitely brought in the Engineers Club of Philadelphia and the Engineering Societies of New England. The Engineers Society of Western Pennsylvania, Engineers Club of St. Louis, and Michigan Engineering Society have voted to recommend to their executive committees that they join. Membership is under consideration by the Louisiana Engineering Society, Illinois Engineering Society, and Cleveland Engineering Society. Interest has been manifested by several others.

The New GROUND GRIP TIRE

FOR TRACTORS AND FARM IMPLEMENTS

Deep, Rugged Tread—Specially Designed for Farm Use—Gives Greatest Traction and Economy

The demand for rubber tires on tractors and farm implements is growing by leaps and bounds. The new Firestone Ground Grip Tire has a big, extra rugged, specially designed tread that cleans itself and is built with 54% more rubber, to give extra traction. In fact, this new tire will pull a tractor or farm implement through any muddy road or soft ground of any kind.

The rugged traction tread is securely held to the Gum-Dipped cord body by the Firestone patented construction of two extra layers of Gum-Dipped cords under the tread.

There is a new Firestone Ground Grip Tire in a size to fit every make and model of tractor or farm implement. You can't afford not to investigate the advantages of a tire like this!

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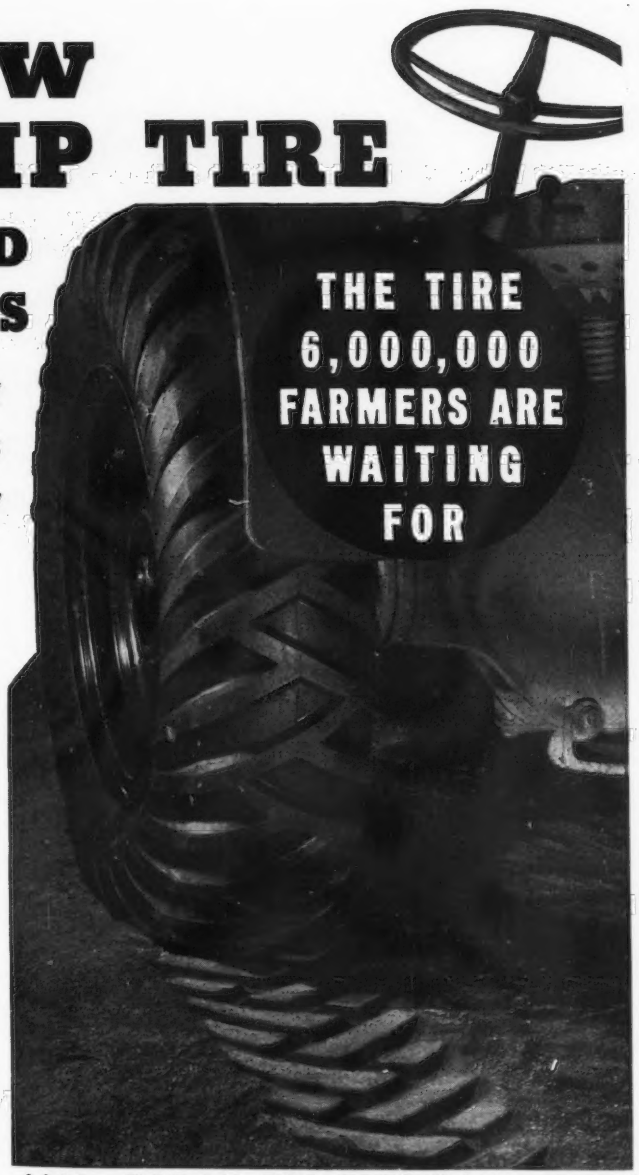

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40-hp "Caterpillar" Diesel Tractor with "Caterpillar" No. 2 Terracer—terracing a Georgia peach orchard.

The world's record low cost for moving soil on a terracing job is held by the "Caterpillar" Diesel Seventy-Five Tractor and Power-Controlled Elevating Grader in Kansas—$0.0031 per cu. yd. (including fuel, lubrication, repairs, wages and depreciation). Here is economy to make the terracing of entire watersheds practical—in the land of few fences and moderate slopes.

●

With the self-loading rotary scraper made for it, the responsive "Caterpillar" Diesel Fifty Tractor quickly and economically raises the ridge where the terrace crosses a small gully—providing extra strength at this point to prevent a break-over. This outfit also finishes off ends of terraces, helps build outlets and moves soil to fill low spots.

COST-BEATING OUTFITS

Balanced combinations to fit all terracing needs in the Soil Improvement Program

Interest in terracing increased by leaps and bounds when soil-improvement specialists started using the 40-hp "Caterpillar" Diesel Tractor and No. 2 Terracer. Balanced "Caterpillar" outfits like this one are now building terraces in scores of communities. This versatile, easy-handling combination builds effective terraces of all types — backs accurately on grades —

Request the 56-page illustrated "Caterpillar" Booklet, "Crops or Canyons", showing terracing equipment, methods and results.

- - - that make big projects roll!

"Caterpillar" Diesel Fifty Tractor with "Caterpillar" 66 Grader building a broad-base terrace in Kansas.

maneuvers quickly in small fields. The per acre costs are so low that farmers by the hundreds have eagerly engaged the terracing services of 40-hp "Caterpillar" Diesel outfits.

Where fields are large and slopes are gradual — and where groups of farmers or individuals have an acreage to terrace that justifies the purchase of still larger equipment — the "Caterpillar" Diesel Fifty Tractor and 66 Grader with 12-foot blade achieves even greater savings. This longer blade builds the broader type of terrace at a lower cost, and is especially suited to the Great Plains area.

The "Caterpillar" line of terracing equipment is complete — a balanced combination of teamed machines to fit all terracing needs of soil improvement programs — from smallest to largest.

At work in the Minnesota Forestry Service is this "Caterpillar" Twenty-Two Tractor and No. 1 Terracer. With an easily-handled outfit like this one, any farmer is equipped to terrace his fields as he wants the job done. And he has the tractor for year 'round power duty.

Man-power and "Caterpillar" power are being used logically by the Federal agencies to stop gully erosion and rebuild fertility. This Diesel Fifty Tractor, with the trail-builder designed for it, slopes the banks of a deep gully—making ready for CCC labor to plant black locust trees.

Caterpillar Tractor Co.
Peoria, Illinois

Agricultural Engineering Digest

(Continued from page 155)

CORROSION OF FERROUS METALS IN ACID SOILS, *I. A. Denison* and *R. B. Hobbs*. [U.S.] Bur. Standards Jour. Res., 13 (1934), no. 1, pp. 125-150, figs. 11. Studies of the corrosiveness of acid soils toward ferrous metals are reported in which a laboratory corrosion test was used, and corrosion test data on specimens removed from test sites were compared with certain physical and chemical properties of soils. The corrosion data from the field tests include measurements of loss of weight and depth of pits on specimens of a variety of ferrous materials removed after 8 and 10 years' exposure to 37 acid soils.

In a preliminary study of corrosion in a synthetic soil composed of pulverized quartz and agar, it was found that the loss of weight of the test specimens increased markedly with increasing acidity within the range of acidity shown by soils. The low rate of corrosion within the range of mild alkalinity was attributed to the action of an adherent film or layer of ferrous and ferric hydroxides which tended to diminish the accessibility of oxygen to the cathodic surface. The high rate of corrosion in the acid range was explained by assuming that the metal ions diffused readily outward into the soil and that the acidity of the soil neutralized hydroxyl ions as they were formed at the cathods, thereby preventing the formation of a protective rust layer.

Comparison of the average rates of pitting of the field specimens at 10 years indicated that the rates of pitting at practically all of the test sites were determined chiefly by the total acidity of the soil. A similar correlation between the loss of weight of specimens and total acidity was obtained when samples of soils from the test sites were employed in the laboratory corrosion test. The correspondence between the field and laboratory data suggests the use of the laboratory test as a convenient means of testing the corrosiveness of acid soils. However, because of the effect of pipe line currents it may be necessary to employ supplementary tests, such as the measurement of soil resistivity.

The pitting factor, defined as the ratio of the maximum depth of pit to the average penetration, diminishes with time and appears to approach a fairly constant value after 8 or 10 years. The pitting factor is shown to be roughly proportional to the ratio of the uncorroded to corroded area on a metal surface.

Measurements of several physical properties of the soil which determine its permeability to air were made in order to relate permeability to the rate of pitting and the distribution of corroded areas. These measurements included the following: (1) Percentage of the total volume of moist soil which is occupied by air; (2) ratio of the moisture required for saturation to the moisture equivalent; and (3) dispersability of silt and clay. Definite correlations were obtained between the values for these properties and the pitting factor, indicating that the greater the permeability of the soil, exclusive of sands, the greater is the tendency for corrosion to be confined to pits, other conditions being the same. An explanation is suggested for the failure of certain very acid and impermeable soils to induce pitting.

THE MEASUREMENT OF FLAME TEMPERATURES IN A PETROL ENGINE BY THE SPECTRAL LINE-REVERSAL METHOD, *S. S. Watts* and *B. J. Lloyd-Evans*. Phys. Soc. (London) Proc., 46 (1934), no. 254, pp. 444-449, figs. 3. Studies conducted at the University of London are briefly reported in which it is brought out that the reversal of a spectral line provides a suitable method for measuring the temperatures which occur during combustion in a gasoline engine. It was found that the maximum temperature in the engine persists for a longer period than the maximum pressure.

REPORT OF THE WATER POLLUTION RESEARCH BOARD FOR THE YEAR ENDED 30TH JUNE, 1933 WITH REPORT OF THE DIRECTOR OF WATER POLLUTION RESEARCH. [Gt. Brit.] Dept. Sci. and Indus. Res., Water Pollut. Res. Bd. and Dir. Water Pollut. Res. Rpt., 1933, pp. III + 50. The texts of these reports are presented. In the studies of the disposal of beet sugar factory effluents, strains of bacteria isolated in previous experiments were examined in the laboratories at the Rothamsted Experimental Station with reference to their action on the carbohydrates sucrose, dextrose, lactose, galactose, maltose, laevulose, and mannitol, and on the ammonium salts of lactic, acetic, and formic acids. It appears that in general those species most active with carbohydrates also most readily attack the salts of the organic acids. Classification in two groups, according to their action either on carbohydrates or on the salts of the acids, has not therefore been possible.

Further laboratory experiments have been made at the Rothamsted Experimental Station on the effects of adding different amounts of phosphate to solutions of sucrose prior to treatment on percolating filters. The solutions, which contained 100 parts of sucrose per 100,000, were filtered at the rate of 100 gal per day per cubic yard of filtering material. In the absence of phosphate very little biological oxidation of sucrose occurred, but in the presence of phosphate in the amounts added—0.3 and 3.0 parts P_2O_5 per 100,000 in different experiments—active biological films were deposited on the media of the filters; and under certain conditions the biochemical oxygen demand of the treated effluent was less than 2 per cent of that of the original solution, a result equivalent to the high degree of purification of more than 98 per cent. It thus appears that there may be some advantage in adding phosphate to beet sugar factory effluent to be treated on a percolating filter, especially during the early stages of operation of the filter to encourage the rapid development of the active biological film necessary for efficient purification of the effluent.

Preliminary laboratory experiments on various methods of treatment of effluents containing milk also were carried out at the Rothamsted Experimental Station. In the first series of experiments it was found that milk diluted with water to contain 1.3 per cent of milk can readily be oxidized biologically by filtration through gravel at a rate of 100 gal per day per cubic yard of filtering medium. The process, however, rapidly diminishes in efficiency owing to the deposition of a thick spongy mass of film in the upper layers of the filter which in consequence soon becomes clogged. Later experiments showed that this difficulty can be overcome by treatment of the effluent in two stages. In the first stage the effluent is stored in a tank for one or two days when fermentation occurs with the separation of fats and protein. The liquid from the fermentation process is then oxidized in percolating filters. Further experiments are in progress with the object of ascertaining the conditions necessary for maximum efficiency of purification.

Preliminary experiments also were made at the Rothamsted Experimental Station on the biological oxidation of aqueous suspensions of cellulose, in the form of wood pulp, by means of percolating filters and by the activated sludge process. This work was undertaken because cellulose is an important constituent of domestic sewage and of certain trade wastes. Under the conditions of the experiments very little of the cellulose in a suspension containing 50 parts per 100,000 in distilled water was oxidized by the activated sludge process. With percolating filters the results were much more satisfactory, and approximately 70 per cent of the cellulose was oxidized when the suspension was filtered at a rate of about 100 gal per day per cubic yard of filtering material.

THE USE OF THE TRACTOR IN TRINIDAD FOR SUGAR CANE CULTIVATION, *C. R. Massy* and *D. D. Paterson*. Trop. Agr. [Trinidad], 10 (1933), no. 10, pp. 280-285 + V-VIII, pls. 4, figs. 2. The use of the tractor for sugar cane cultivation in Trinidad is described, together with the tillage equipment employed. Cost data also are included.

It has been found that on Trinidad sugar cane estates only heavy, high-power tractors of the tracklaying type are suited to the type of work to which they are put. Any tractor of less than 30 hp or of less than 5 tons in weight has been found uneconomical owing to the high maintenance cost and the low power output.

NOTES ON THE CHLORAMINE TREATMENT OF WATER, *S. Elliott*. Jour. Roy. Army Med. Corps, 61 (1933), no. 3, pp. 161-179; abs. in Bul. Hyg., 8 (1933), no. 12, pp. 817, 818. These notes relate primarily to the treatment of small scale water supplies. The ammonia may be used in the form of gas from cylinders, but care must be taken to keep the ammonia gas away from the chlorine gas until they are mixed in dilute solution.

The chloride and sulfate of ammonia are convenient salts to use instead of the gas. Chlorine may be used as gas or as bleaching powder or as any of the other commonly used chlorine substances, provided the percentage of available chlorine is known. The ammonia and chlorine may be mixed and then added to the water, or the ammonia may be added first and after a thorough mixing the chlorine may be added subsequently. The proportions of the two substances required are in both cases about 4 parts of chlorine to 1 part of ammonia.

Experiments showed that chloramine will kill *Bacterium coli* when in a concentration of 1 ppm of either river water or in filtered mixtures of sewage and water. It is not so rapid in its action as chlorine and has no greater penetrative power.

MODERN ELECTRIC AND GAS REFRIGERATION, *A. D. Althouse* and *C. H. Turnquist*. Goodheart-Willcox Co. (Chicago), 1933, pp. [8] + 265, figs. 135. This is a handbook of technical information on household refrigeration. It contains chapters on fundamentals of refrigeration, the compression cycle, the absorption cycles, refrigerants, conventional compression cycle refrigerators, rotary and hermetic compression cycle refrigerators, the domestic absorption refrigerator, automatic controls, installing and putting refrigerators in service, servicing, electric motors and gas supply, service data, refrigerator boxes and insulation, and technical characteristics.

(Continued on page 166)

Use the TERRACER

WITH THIS EXCLUSIVE FEATURE!

HIGH BANK Cutting

High blade position and long side shift are A-C features of vital importance in cutting down old bench terraces

For use with the Allis-Chalmers Model "KO" Oil Tractor ... 48 Drawbar H. P. ... Hillside or Standard Tread

FOR tearing down old bench terraces — a serious problem — exceptionally high blade position is an exclusive advantage of the Allis-Chalmers Terracer. Without stopping the tractor to make changes or adjustments, the moldboard can be placed in a high bank cutting position . . . to pull down old terraces 3 to 5 feet high.

The circle assembly has a side shift of 40 inches, providing long blade reach outside the wheels . . . another definite Allis-Chalmers advantage.

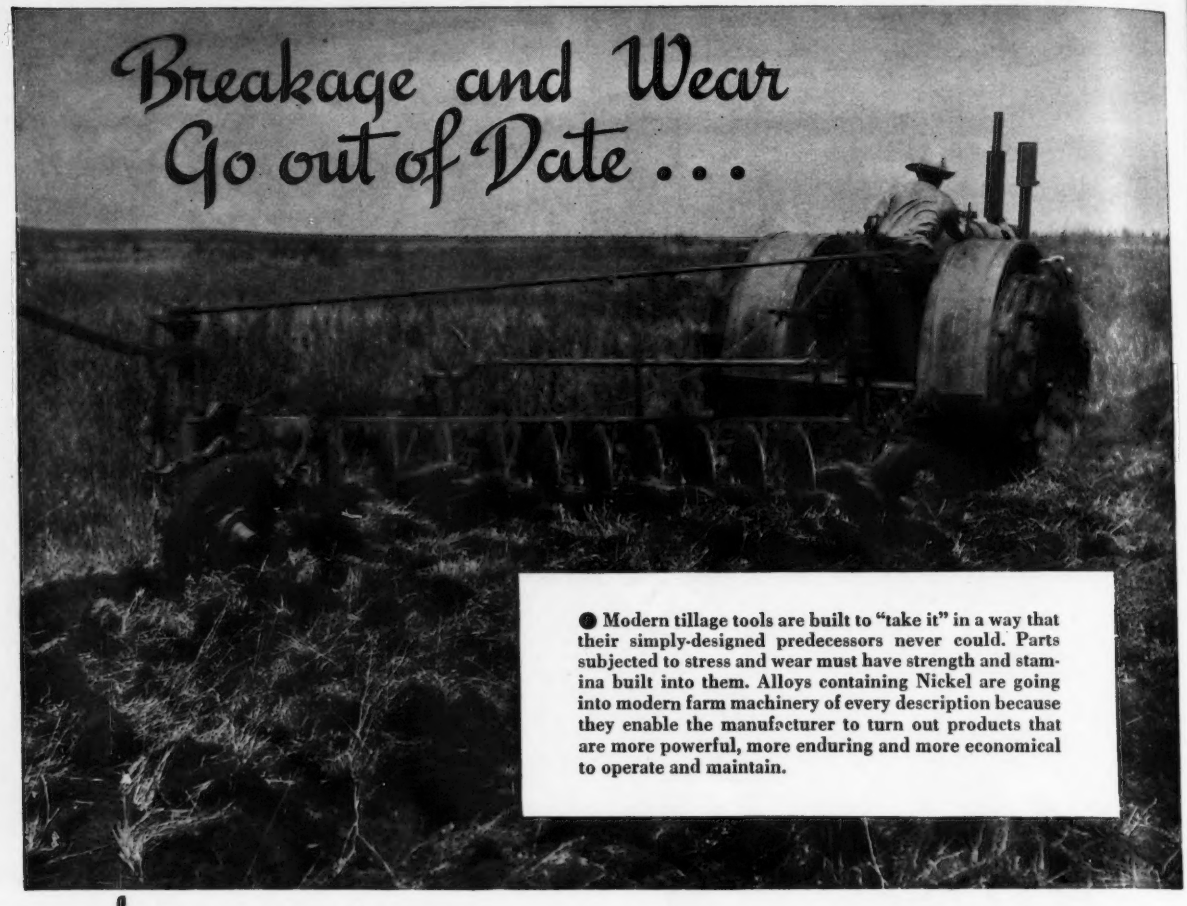
All-bolted construction — alloy bolts in fitted holes with double thickness nuts — is assurance against failures. A heavy spring provides an effective cushion against shocks. The exclusive wide frame construction increases stability on steep slopes. Provision is made for taking up wear in ball and socket connections.

Use the Terracer that was built to "Job Requirements". Write for descriptive folder.

ALLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

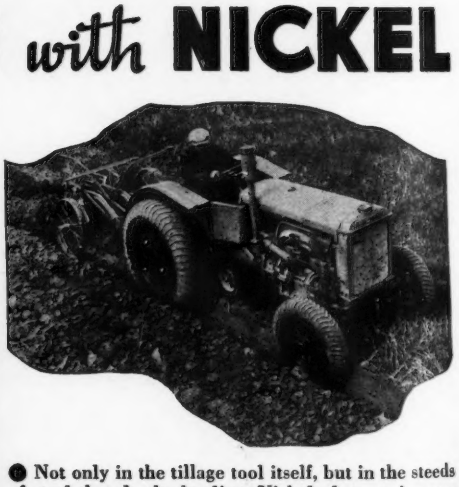
Breakage and Wear Go out of Date . . .



● Modern tillage tools are built to "take it" in a way that their simply-designed predecessors never could. Parts subjected to stress and wear must have strength and stamina built into them. Alloys containing Nickel are going into modern farm machinery of every description because they enable the manufacturer to turn out products that are more powerful, more enduring and more economical to operate and maintain.

. . when you MODERNIZE with NICKEL

● In equipment of this type—driven at accelerated speeds—stress, impact, shock, abrasion and wear are tremendously increased. Because Nickel Alloy Steels offer superior resistance to these conditions, they are ideal for bolts, nuts, studs, gears, shafts, and other highly-stressed parts.



● Not only in the tillage tool itself, but in the steeds of steel that do the hauling, Nickel plays an increasingly important role. In addition to many Nickel Alloy Steel parts, the modern tractor is also equipped with hard, strong, tough Nickel Cast Irons. When made of these materials, engine blocks, cylinder liners, heads, brake drums, etc., are made more highly resistant to pressure, heat and wear. You may feel free to consult our engineers at any time regarding your problems.

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How You Can Sell More Domestic Water Systems

Free, for use in your newspaper advertising, a two-column-wide mat of this attractive illustration

USE FACTS LIKE THIS: 45 to 60 *tons* of water are carried annually for household uses alone, in a home where a water system has not been installed. One person's time for one solid month is required—if one person does it all—and that person walks hundreds of miles to complete this back-breaking job. *A good domestic water system lifts this load from the shoulders of the womenfolks*—gives them more time for better things. And it works faithfully, year after year, for but a few cents a day. The publication offered you on this page is packed with valuable information that you can use to boost your sales. Use it. It will help you.

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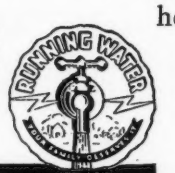
General Electric motors for domestic water systems are built the way you would build them to make your selling job easier. *Built by men who know motors, for men who know pumps,* these motors assure long, carefree operation under adverse conditions. They need only a few drops of oil once a year to keep them running smoothly. They are quiet. Their properly designed bases enable the man of the house to adjust the belt tension quickly and easily. Their handy provision for easy inspection of commutator and brushes is an appreciated convenience.

Ask that the pump you sell have a motor as modern, as finely built, as dependable, as the pump itself—a GENERAL ELECTRIC MOTOR. And for maximum customer satisfaction, connect it to a G-E automatic pressure switch with G-E wire.

(Right) This seal, as a window sticker, and a running-water animated window display are available through the Electric Water Systems Council, 228 West Ontario St., Chicago, Ill.



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GENERAL ELECTRIC

Agricultural Engineering Digest

(Continued from page 162)

EQUILIBRIUM VOLATILITY OF MOTOR FUELS FROM THE STANDPOINT OF THEIR USE IN INTERNAL-COMBUSTION ENGINES, *O. C. Bridgeman.* [U.S.] Bur. Standards Jour. Res., 13 (1934), no. 1, pp. 53-109, figs. 23. This paper reports the experimental data and conclusions from a study conducted over a period of years at the Bureau of Standards of fuel volatility. An apparatus and method are described for the measurement of the equilibrium volatility of motor fuels, and experimental data are presented on 38 gasolines and blends covering a wide range of volatility.

A correlation is shown to exist between equilibrium volatility data and distillation data obtained by the standard method of the American Society for Testing Materials. By use of the equations deducted it is possible to obtain from distillation data all of the equilibrium volatility data of interest in connection with engine performance.

ARKANSAS FARM HOUSING CONDITIONS AND NEEDS, *D. G. Carter.* Arkansas Sta. Bul. 305 (1934), pp. 35. This bulletin presents the results of a study of housing conditions and needs conducted in Arkansas in the winter of 1933-34. Data were secured on sample areas in seven counties, and included about 8.4 per cent of the farms of the state and 9.3 per cent of the farm population. The study was part of a farm housing survey covering 300 counties in 48 states, conducted by the U. S. Department of Agriculture in cooperation with the state agricultural colleges, and financed by the Civil Works Administration. The seven counties included in the survey were Arkansas, Drew, Faulkner, Hempstead, Izard, Phillips, and Washington. These counties are representative of the various areas of the state, and as a whole are typical of the entire state.

The proportion of tenants included in the survey was 62 per cent compared to 63 per cent for the state. The proportion of negro farmers represented in the housing survey was 33.6 per cent, compared to 32.6 per cent for the state.

The conclusion seems justified that the survey presented an accurate indication of conditions in the entire state, and that averages or percentages may be applied directly to the state as a whole and totals multiplied by twelve for the entire state. The typical average farm home in Arkansas is a four-room house of frame construction, one story high, without basement, with one or two porches. The average number of regular occupants per house was 4.37 for white owners, 4.795 for white non-owners, 4.58 for negro owners, and 4.838 for negro non-owners. The average number of rooms per house was 4.6 for white owners, 3.9 for white non-owners, 3.8 for negro owners, and 3.66 for negro non-owners. The "rooms per person" for the same groups, was, respectively, 1.05, 0.81, 0.84, and 0.76.

Analyses of white-owner houses in Washington County indicated that 72 per cent of the families were adequately housed, 11.2 per cent had less than the usually needed room, and 16.8 per cent were definitely overcrowded. White non-owners were found to be 48 per cent adequately housed, 15 per cent below usual standards, and 37 per cent were overcrowded. Negro groups in three counties were indicated as 10 per cent adequately housed, 31.4 per cent below standard, and 58.6 per cent were severely overcrowded.

Analyses in Washington County showed that the houses on farms above 100 acres in size averaged definitely larger than on farms of smaller acreage. There was a fairly close relationship between size of house and size of farm. There is practically no difference in the average size of rooms (square feet of area) in houses of from two to six rooms. The superficial area of floor space and the area of the individual rooms progressively decline from the white owner to the negro non-owner groups. Average house areas ranged from 969 to 666 sq ft, living rooms from 274 to 203 sq ft, kitchens from 196 to 141 sq ft, and bedrooms from 205 to 196 sq ft.

Despite the smallness of the average house and indications of crowding, the typical occupant did not express a need for more room. Only 18 per cent of the occupants indicated a need for additional bedrooms, 20 per cent expressed a need for more closet space, and 17 per cent wanted storage space for fruit and vegetables. Living rooms, dining rooms, and porches represented the expressed need of from 5 to 7 per cent of the families. Need for the addition of kitchens, workrooms, wash rooms, halls, bathrooms, and basement was mentioned by comparatively few occupants.

Analyses of house conditions, measured by the several parts of the structure, reflected the lack of care given, especially during the last few years. White-owners homes were definitely in better condition than were the other groups.

Kitchen sinks were the most common item of sanitary equipment found, followed by water pumped or piped into the house, bathtub, lavatory, and flush toilet, in the order named. Less than 10 per cent of the white-owner group had any one item of equipment, and less than 3 per cent had installations of flush toilet and septic tank. Sanitary facilities were almost completely lacking in the negro houses.

Refrigerators, either ice or mechanical, represented the item of labor-saving or comfort equipment most frequently found, occurring in about 15 per cent of the white and 10 per cent of the negro homes. Improved cooking equipment was found in about 10 per cent of the white-owner homes, and electric or gas lighting in about 10 per cent. White non-owners had less than half as much mechanical equipment as the white owners. The negro groups had very little.

The vast majority of desired improvements were repairs to the house, structure, as indicated by the families surveyed. In general, the order of need was (1) interior walls, ceilings, and floors; (2) roof; (3) doors, windows, and screens; (4) exterior walls; (5) foundations; and (6) porches. Next to house repair, additional space was most desired. Water supply was the most desired equipment item.

An appendix is included giving data from an engineering analysis of the structural materials, quantities, and costs for necessary repairs, additions, and new construction to provide adequate and livable houses.

SECOND PROGRESS REPORT ON THE DEVELOPMENT OF A SMALL ELECTRIC MILK PASTEURIZER. *A. V. Krewatch.* (C.R.E.A.) Natl. Rural Elect. Proj., College Park, Md., Rpt. M-17 (1934), pp. 15, figs. 10. This report gives results of further investigations in the development of an electric pasteurizer for the use of dairymen producing small quantities of market milk.

The additional studies reported were for the purpose of determining the best materials and proportions for container and electrodes; permissible designs embodying electrical safety, economy, cleanliness, and simplicity; and the determination of the electrical resistance of milk. The maximum permissible power demand was placed arbitrarily at 60 a at 110 v to permit use of the pasteurizer on the ordinary 60-a service.

The results showed that the electrical method of heat pasteurization of from 8 to 20 gal of milk in a batch-type pasteurizer seems to be entirely feasible. The quality of product is satisfactory, and further tests may show it to be better and more uniform than milk pasteurized by other methods.

The rectangular-shaped pasteurizer with carbon-plate electrodes has the advantages of more uniform heat distribution and insulation of electrodes permitting the use of 220 v across electrodes in the larger units. Graphitized carbon proved to be the most satisfactory electrode material.

An accurate, dependable thermal control should be provided. For holding periods of 7 min or less, this control need only cut off the power and the pasteurizer will require no insulation. For longer holding periods a thermostat with a control sensitivity of 0.5 deg or less should be used, or the pasteurizer should be thoroughly heat insulated.

Based on these tests, a 10-gal cylindrical pasteurizer to be used in a 110-v, 60-a circuit should have the following approximate dimensions: Tank 22 in in diameter by 8 in deep, with glass plate over bottom; and center carbon electrode 3 in in diameter by 8 in long. Such a pasteurizer should heat 10 gal of milk from 80 to 149 deg F in 30 min with a maximum demand of 50 a.

A rectangular pasteurizer with characteristics similar to the above should be approximately 16 by 12 in and 14 in deep, with carbon plate electrodes 13 by 14 in by $\frac{3}{8}$ in spaced 11 in apart. These dimensions would be changed somewhat if the electrodes could be sealed into the ends of the tank.

CAUSES OF DETONATION IN PETROL AND DIESEL ENGINES, *G. D. Boerlage* and *W. J. D. Van Dyck.* Inst. Auto. Engin. (London) Journ., 2 (1934), no. 7, pp. 11-40, figs. 22. An extensive technical analysis of detonation in gasoline and Diesel engines is presented, from which the view is advanced that it is correct to look at the phenomena of combustion in Diesel engines and in petrol engines from the same aspect. In both cases the number of collisions of activated reagents is decisive, and self-ignition may be influenced equally by activated oxygen as by activated hydrocarbon. It cannot be overlooked that in the petrol engine unstable peroxide-like compounds formed early during the compression stroke may have some influence. Their effect will at most produce an effect on the main phenomenon of autoignition of the end gas under Diesel conditions. Detonation or "pink" may occur in any class of engine and is a vibration in the air charge due to a local rapid pressure rise. As such it is most commonly met in a pinking petrol engine but it occurs also in Diesel engines. On the other hand, "knock" indicates mechanical vibration, mainly of walls, due to a rapid pressure rise, and is inherent to the petrol pink as well as, in many cases, to the Diesel process. The term "bumpy running" may be reserved finally for those cases where heavy engine parts, i.e., crankshaft, are set in vibration. *(Continued in page 170)*

O. J. Anderson, Lansing, Iowa, at age 91, with a John Deere Plow he bought in 1855 and used for 60 years

What John Deere Quality Means

QUALITY is a word much abused. Just what, then, is the meaning of "John Deere Quality?"

Forget for the moment the combine, the tractor, all the myriad machines of the ten John Deere factories, all the progress and expansion in three generations of service to agriculture. Go back to the humble implement which, created by John Deere himself in 1837, formed the foundation of the John Deere line—the steel walking plow.

* * * * * *

Learn the story of the oldest John Deere plow you can find. Ask the owner how many thousand acres it has turned, then notice the thickness and hardness of the high-carbon steel layer that gave this endurance. Reduction of wear, by effective lubrication where practicable, by replaceable parts, and by generous use of resistant materials, brings long life—and long life looms large in John Deere quality.

See if you can tell whether the original share is still in use or whether it has been replaced. Genuine John Deere repairs fit and work like originals, and that, too, is a part of John Deere quality. Ask the owner how many times the original share could be re-forged, thanks to the grade and amount of metal provided.

Get the owner to recall the strains his old plow has stood without springing the beam or suffering a break. Ask him how little, if anything, has been his repair expense and how easy it was to secure and install the parts. Strength for emergencies, and ease, promptness and economy of repair help to round out John Deere quality.

Above all, learn how well his plow has done its work; how well it scoured in sticky soil, how well it penetrated and pulverized when the ground was hard, yet how easy on man and team. Of all the things that John Deere quality includes, perhaps the greatest is dependability under adverse conditions, the ability to get the job done when Nature seems determined to cheat the farmer of his crop, plus excellence of performance under all circumstances.

* * * * * *

Add all these qualities together; give to each its proper importance; balance them against the purchase price and operating costs. That the final answer shall be the best possible value for every dollar invested—that each such dollar of investment shall earn the greatest number of dollars in farm profit—is the meaning of John Deere quality which each John Deere factory is determined to build into every product that bears the John Deere name.

JOHN DEERE FARM EQUIPMENT

Leader in Quality for Nearly a Century

Agricultural Engineering Digest

(Continued from page 166)

THE QUALITY OF THE WATERS OF SOUTHEASTERN NEVADA, DRAINAGE BASINS AND WATER RESOURCES, *G. Hardman* and *M. R. Miller*. Nevada Sta. Bul. 136 (1934), pp. 62. Analyses of a large number of samples of water from an area in Southeastern Nevada, including the counties of Clark, Lincoln, White Pine, Nye, Esmeralda, and Lander, are summarized and discussed.

Some water supplies in this area cannot be said to be free from objection on account of the salts held in solution. In many cases there is no indication that such waters are directly harmful, but their alkaline or brackish taste has a tendency to prevent the use of as much as may be needed by the body. In general the waters are fair for domestic use and good for irrigation. It is noticeable that usually the quality of the waters near the foot of the mountain slopes is better than farther out in the valleys. The waters from the springs and artesian wells in the Las Vegas and Pahrump Valleys are normally of better quality than the surface waters or the waters from the non-flowing artesian wells toward the centers of these basins. The drainage waters in the Las Vegas Valley are very often highly mineralized. The waters of the Amargosa Valley are highly mineralized and of only fair quality for irrigation or domestic uses. The value of the waters for irrigation is lessened by the unusually high sodium content, while the large amounts of dissolved matter impair the quality for domestic use.

The waters of the White River, Geyser, Meadow, Railroad, and Pahranagat Valleys are shown by the analyses to be of good quality for irrigation and domestic uses. The water from the springs in the Moapa Valley is somewhat more concentrated than usual for the White River drainage basin and is not of the best quality for either domestic or irrigation use. However, the water is potable, and when the lands to be irrigated are provided with adequate drainage the water can be used without harm to the soil. The presence of a relatively large percentage of calcium and magnesium in the water appears to prevent the fixation of sodium in the soils on which the water is used and the sodium is leached out in the drainage water.

Chemically the waters of the Virgin River springs are poor, being so highly charged with salts as to be almost totally unfit for domestic use. Only the very high proportion of gypsum to the other salts makes these waters usable for irrigation, and even with this favorable composition of the salts it appears likely that severe injury to the soil would follow their long continued use without the assistance of the annual flushing of the soil with the snow water flow of the river.

In quality, the waters from nearly all sources in the Steptoe Valley are shown to be good for irrigation and fair to good for domestic uses.

The quality of the waters in the Reese River Valley varies within wide limits. In general, the waters in the valley south of Austin, where the contributory mountain ranges are lofty and the run-off high, are good for irrigation and domestic uses. Farther north, toward the center of the basin, the quality becomes poorer, though there are many sources of very good water.

The several streams which enter the upper Big Smoky Valley from the Toyabe Range all have water of good quality. Many springs are found along the west side of the valley where the alluvial slopes are short and steep and the water has but a short distance to travel from its source in the mountains. Practically all of these springs and the artesian wells in the spring areas give water of excellent quality for both domestic and irrigation uses.

A table of definitions and conversion factors is included.

EFFECT OF BOTTOM VENTILATION ON PURIFICATION BY AN EXPERIMENTAL TRICKLING FILTER, *M. Levine* and *H. E. Goresline*. Iowa Engin. Expt. Sta. Bul. 116 (1934), pp. 16, figs. 2. Studies are reported on treating skimmilk solutions on a small trickling filter constructed to permit thorough natural bottom ventilation or complete elimination of bottom ventilation.

The two filters employed in the experiments were 2 ft square, 6 ft deep, and constructed of galvanized sheet iron. Two-foot lengths of 1-in galvanized iron pipes laid across the bottom of the filter with approximately 1-in spaces between them served as supports for the filling material, which consisted of about 6 in of quartzite (2 to 3-in size) placed directly on the pipes and 5.5 ft of carefully washed cinders, or rather clinkers (⅝ to 2 in in size). For the upper 6 in of the filling material, extra coarse clinkers (2 to 4-in masses) were employed with a view to reducing the washing effect on the surface of the filter while dosing.

The skimmilk waste was applied at a rate of approximately 840,000 gal per acre per day for about 14 hr daily, the rate of dosing on a 24-hr basis thus being approximately 500,000 gal per acre. The long rest period (8 to 10 hr) closely simulated the conditions in small creameries. The dosing cycle was about 4 min.

The experiments show definitely that elimination of bottom ventilation resulted in a rapid decrease in the purifying efficiency of the filters. This was indicated by a marked reduction in nitrates, increases in ammonia, organic nitrogen, and acidity, and a marked rise in the biochemical oxygen demand of the effluent. Elimination of bottom ventilation was quickly followed by severe clogging of the filter. Opening the bottom vents, after a filter had become clogged, did not result in very rapid recovery until after the filter had been washed.

With the filling material employed and the high concentration of waste applied, bottom ventilation was indispensable to efficient functioning. In spite of the 8 to 10-hr daily rest period (when the filter was empty of applied waste, and during which time ample opportunity for diffusion of air through the top was available), the filter rapidly decreased in efficiency if the bottoms were closed. Neither washing nor chlorinating the filters improved the effluent as long as the bottoms remained closed. Opening the filter bottoms, permitting access of air, resulted in improvement which was markedly accelerated by washing out accumulated clogging material.

FLAME TEMPERATURES IN AN INTERNAL-COMBUSTION ENGINE MEASURED BY SPECTRAL LINE REVERSAL, *A. E. Hershey* and *R. F. Paton*. Ill. Engin. Expt. Sta. Bul. 262 (1933), pp. 50, figs. 15. The line-reversal method of temperature measurement, as previously applied to the measurement of the temperature of stationary flames, was adapted to measure the flame temperature in an internal-combustion engine. Using an ordinary gasoline and moderate compression pressures, temperatures were measured over a sufficient portion of the operating cycle to determine the maximum flame temperature during combustion for varying air-fuel ratios within the combustion limits. These maximum flame temperatures were compared with those computed for representative air-fuel ratios, considering the effect of residual exhaust gas, variable specific heat, and dissociation, but neglecting heat loss. The effect of spark timing on the flame temperature was also determined for a limited range of operating conditions.

The results of the investigation indicate that the flame temperature found from a line-reversal measurement is characteristic of thermal equilibrium, established throughout the gases in the engine cylinder early in the process of burning and maintained during the subsequent expansion. The maximum flame temperatures for a compression ratio of 3.86:1 were found to vary from 3,750 deg F abs, with the richest and leanest air-fuel mixtures, to 4,450 deg with an air-fuel ratio of 13.9:1. The maximum observed flame temperatures and the corresponding calculated temperatures were found to be in closest agreement for the normal operating range of air-fuel ratios between 12:1 to 14:1. Throughout this range the calculated values were approximately 600 deg higher than the observed values. With either richer or leaner mixtures the difference increased and reached a maximum of 1,000-deg at the lean-combustion limit.

Since some of the discrepancy between the calculated and the observed maximum temperatures is undoubtedly due to experimental errors, the most likely of these were considered and their upper limits estimated. If the observed values were increased by these amounts they would still be from 200 to 600 deg below the calculated temperatures. It would therefore seem probable that this remaining difference is due to an inadequate analysis of the actual combustion process.

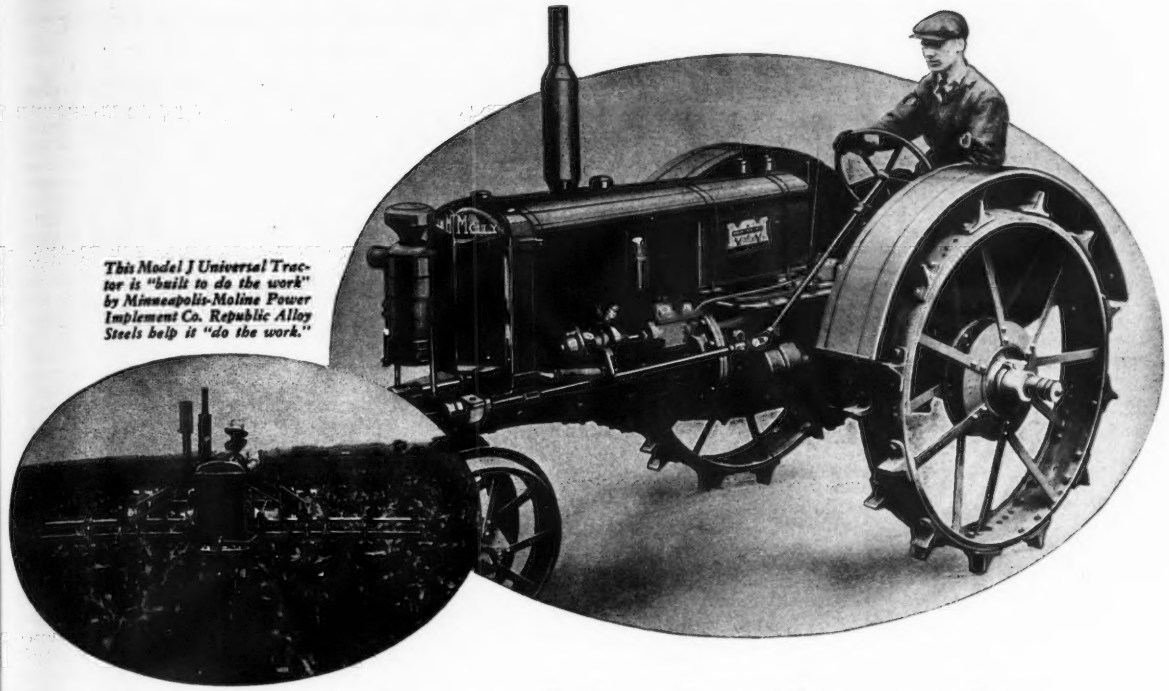
The concentrations of the gases in an engine cylinder may be calculated when the temperature and pressure are known, hence the measurement of temperature, independent of the other thermodynamic variables, makes it possible to study the progress of the chemical reactions and equilibrium at high temperatures.

ON SETTING THE CREST ELEVATION FOR THE PARSHALL FLUME, *H. A. Wadsworth*. Hawaii. Planters' Rec., 38 (1934), no. 2, pp. 157-159, fig. 1. This brief note outlines a procedure by which the proper elevation of the crest of the Parshall flume may be determined before the construction of the device is begun.

CORN AND SOYBEAN PRODUCTION, *H. T. Barr*. Louisiana Sta. Bul. 253 (1934), pp. 4. Practical information is given on methods and mechanical equipment used in corn and soybean production, including seedbed preparation, planting, cultivation, harvesting, and use of the pulverator. A labor and power summary is included.

ARKANSAS FARM HOUSE PLANNING, *D. G. Carter*. Arkansas Sta. Bul. 306 (1934) pp. 29, figs. 16. This bulletin presents data relating to farm housing needs, conditions, and costs in Arkansas, together with a series of house designs adapted to the needs of the state. The plans, illustrations, and working drawings were completed in cooperation with the federal Civil Works Administration.

(Continued on page 172)



This Model J Universal Tractor is "built to do the work" by Minneapolis-Moline Power Implement Co. Republic Alloy Steels help it "do the work."

In the toughest kind of service . . .
REPUBLIC ALLOY STEELS CARRY ON

Soil and weather are cruel. Agricultural machinery of the worth-while kind must never compromise quality for price. Yet price must ever be kept in mind if the equipment is to be sold profitably.

Republic Steel has worked to this end with agricultural equipment makers for many years —has produced lighter weight, stronger alloy steels that have revolutionized design and made available in every farming community longer-lasting equipment at prices that the user can afford to pay.

A list of the users of Republic Alloy Steels in the farm implement field would be a directory of nearly all the reputable makers of equipment. They know the advantages of using dependable steels in their products. They know how important it is, from the standpoint of future sales, that their products reflect, in their service to the farmer, the utmost in value for every dollar spent for materials. And so they put their problems up to us knowing that Republic will help them keep faith with their customers. We can do the same for you, too.

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TWIN DISC CLUTCHES

Twin Disc Clutch Company
1332 Racine Street
Racine, Wisconsin

Agricultural Engineering Digest

(Continued from page 170)

THE STRENGTH OF SCREW THREADS UNDER REPEATED TENSION, *H. F. Moore* and *P. E. Henwood*. Ill. Engin. Expt. Sta. Bul. 264 (1934), pp. 20, figs. 7. Tests are reported which were undertaken to obtain data on the behavior under repeated tensile load of ⅜-in studs with three kinds of screw threads, and of ⅜-in studs made from ordinary low-carbon steel, and ⅜-in studs made from a heat-treated alloy steel. A comparison was also made of the effective stress concentration at the root of thread as shown by repeated stress tests to destruction, and the stress concentration as shown by tests of pyralin models examined under polarized light.

Three different lots of metal were used for making the test studs which were subjected to repeated stress: (1) A plain carbon steel rod containing about 0.30 per cent carbon designated as medium carbon steel, (2) a plain carbon steel rod containing about 0.30 per cent carbon, and also designated as medium carbon steel, on which threads had been formed by cold rolling along its entire length; and (3) a rod of SAE 2320 steel with a nickel content of about 3.25 per cent and a carbon content of about 0.20 per cent. The two plain carbon steel rods were tested as received. The 2320 steel was heated to 1,500 deg F, quenched in oil, and drawn at 800 deg.

The stress-concentration factor for a screw thread is defined as the ratio of maximum stress, which is at the root of the thread, to the average stress over the minimum area of cross section of the thread. This factor may be determined directly by photo-elastic tests. The effective stress concentration factor is defined as the ratio of the endurance limit of the metal itself to the endurance limit of specimens which fail in the screw threads. The tests taken in connection with previous photo-elastic tests indicate that the stress-concentration factor determined by photo-elastic tests is larger than the effective stress-concentration factor determined by fatigue tests. In other words, determination of stress concentration in screw threads by photo-elastic tests gave results on the safe side as compared with those given by fatigue tests. Both photo-elastic tests and fatigue tests of ⅜-in studs gave higher stress-concentration factors for die-cut U. S. Standard threads than all die-cut Whitworth threads.

Rolled threads on a medium carbon steel rod ⅜ in in diameter gave effective stress-concentration factors intermediate between those for die-cut Whitworth threads and those for die-cut U. S. Standard threads, but this superiority over the U. S. Standard die-cut threads may be explained by the fact that the rolled-thread specimens were threaded for the full length, while the die-cut specimens were threaded at the ends only.

For both U. S. Standard threads and Whitworth threads higher effective stress-concentration factors were found for heat-treated nickel steel studs than for medium carbon steel studs. This indicates that the heat-treated nickel steel is more sensitive to stress concentration than is the medium carbon steel, and that a smaller proportion of the tensile strength of the material is available in heat-treated nickel steel bolts and studs subjected to repeated stress than is the case with ordinary structural steel bolts and studs. For heat-treated nickel steel studs with ⅜-in U. S. Standard threads an effective stress-concentration factor of 3.85 was observed. For medium carbon steel this factor was 2.84. These figures suggest that for bolts or studs subjected to repeated tensile stress a safe estimate of the stress at the root of the thread would be not the nominal value P/A, but $3\,P/A$ for ordinary structural steel, and $4\,P/A$ for heat-treated alloy steels commonly carried in stock, where P is the load in pounds and A is the area at the root of the thread in square inches.

HOUSEHOLD EQUIPMENT, *L. J. Peet* and *L. E. Sater*. John Wiley & Sons (New York); Chapman & Hall (London), 1934, pp. XI + 315, figs. 121. Popular and technical information is given on the subject. Chapters are included on kitchens; materials used in household equipment; fundamentals of electricity; fuels; the electric range; gas; the gas range; coal, gasoline, and kerosene ranges; small equipment, electrical; small equipment, non-electrical; refrigeration; laundry procedure; electrical cleaning equipment; home lighting; home plumbing; and heating and ventilating.

FLOW OF WATER AROUND BENDS IN PIPES, *D. L. Yarnell* and *F. A. Nagler*. Amer. Soc. Civ. Engin. Proc., 60 (1934), no. 6, pp. 783-797, figs. 9. Studies conducted by the USDA Bureau of Agricultural Engineering in cooperation with the University of Iowa are reported. The more outstanding results are presented of a series of experiments on the flow of water around bends of various shapes and various degrees of curvature in 6-in pipes. The experiments are believed to be unique in that with the same quantity of flow the effect on the loss of head resulting from unequal velocity distribution in the pipe approaching the bend was fully investigated.

(Continued on page 174)

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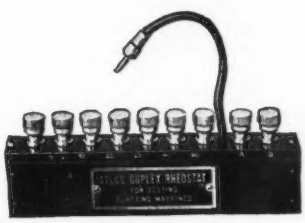

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Agricultural Engineering Digest

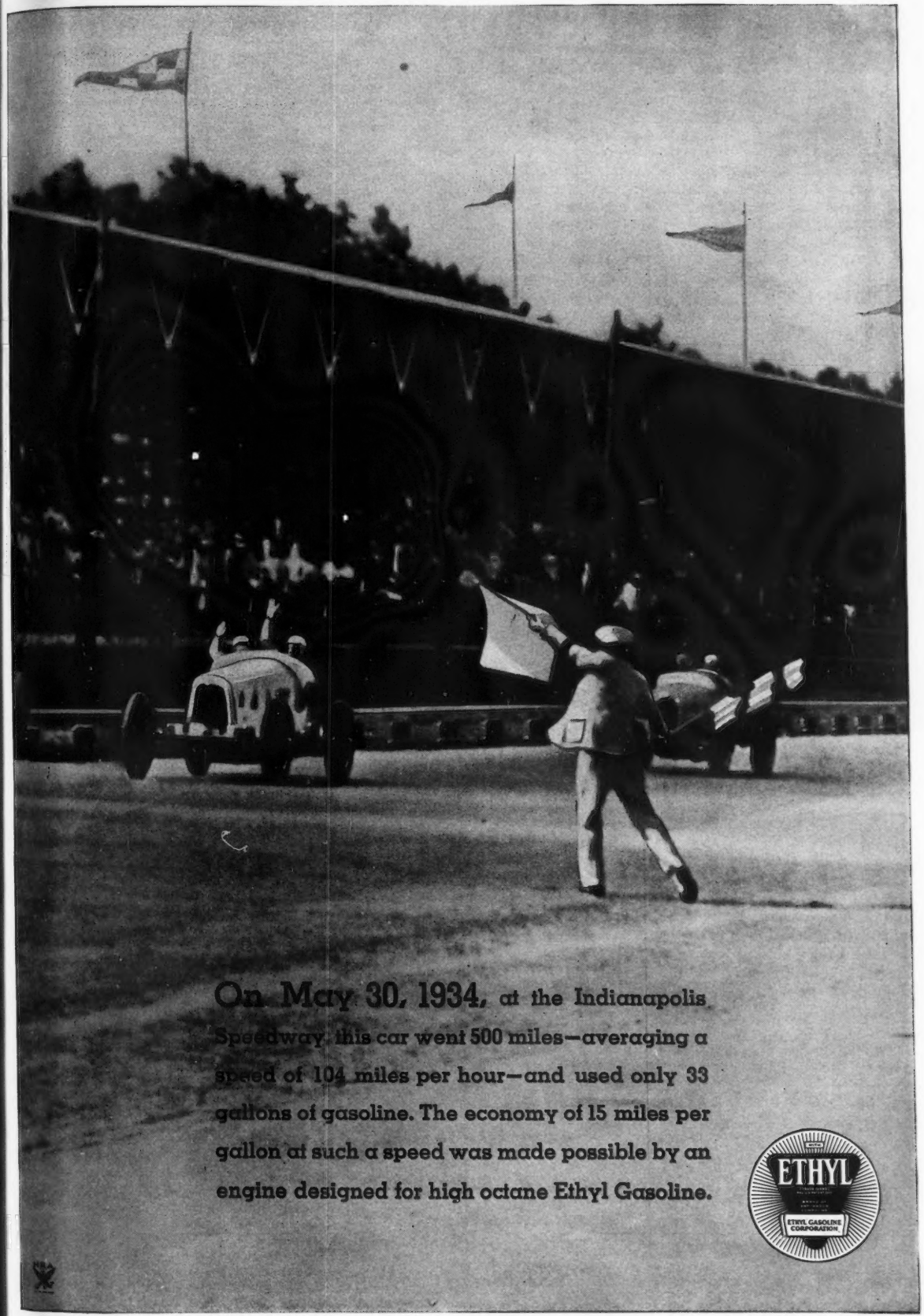
(Continued from page 172)

The experiments show that it is possible to have conditions such that the resistance to flow may be very small or unusually large in the same pipe bend carrying identical quantities of water. In a standard 90-deg 6-in pipe bend, for the same quantity of flow with high velocity on the inside and low velocity on the outside of the approach pipe, the loss of head may be four times as much as would be measured in the same bend when high velocity exists on the outside and low velocity on the inside of the tangent leading to the bend. Present formulas for computing loss of head due to bends appear to apply only to cases in which approximately uniform velocity distribution exists in the approach pipe. The losses of head in the bends experimented upon appear to vary as the square of the velocity and not as the 2.25 power. A pipe bend may be as useful as any other device for the measurement of discharge. The direction of flow of the secondary currents in pipe bends depends entirely upon the velocity distribution in the approach pipe. The same fundamental laws of flow through bends apply to both closed conduits and open channels.

PURIFICATION OF CREAMERY WASTE ON FILTERS AT TWO IOWA CREAMERIES, *W. E. Galligan* and *M. Levine.* Iowa Engin. Expt. Sta. Bul. 115 (1934), pp. 39, figs. 10. The designs of the plants for the treatment of wastes from two Iowa creameries are described and the results of studies made to improve their performance are reported to indicate the procedure necessary to adequately meet the requirements of specific cases.

Literature Received

WOOD STRUCTURAL DESIGN DATA by *R. G. Kimbell, A. T. Upson,* and *M. Ahern.* National Lumber Manufacturers Association, 1337 Connecticut Avenue, Washington, D. C., 1935. 294 pp, 8½x11 in, $1.00. Identified as Vol. I, this publication is replete with information and tables dealing with structural design and use of lumber. It collects for the designer much information for which he heretofore must have resorted to several or many other publications and includes much information not previously available to the architectural and engineering profession. It treats in logical continuity with the first fundamentals with which the architect and the engineer and building designer must be acquainted in order to use wood structurally in a safe and economical manner. The general subjects included in the book are: physical properties of wood, chemical properties of wood, mechanical properties of wood, timber quality strength relations, glossary of lumber terms, abbreviations of lumber terms, board measure, lumber quantity costs, sizes of American standard yard lumber and timber, notations and technical symbols, properties of American standard lumber sizes, wood beams (design; maximum loads limited by deflection; safe loads determined by bending), wood columns (design; safe loads on dressed sizes; safe loads on rough sizes), plank and laminated floors (design; safe loads), references, and decimal equivalents. The manual is made up primarily of factual and mathematical data in such a form that it can be applied to any wood. It makes no attempt to influence the choice of the kind of wood nor does it usurp the place of the architect, the engineer, or specification writer. It provides him with information whereby he can reach a conclusion quickly and easily. In the preparation of the book many architects and engineers were consulted to ascertain their opinion of what information was most needed and how it might be presented for the maximum convenience of the designer and technical professions. As a result the book is unusual in several respects and represents a number of innovations in engineering and architectural handbook arrangement and format. The character of the tabulated data being applicable to all species of wood made it desirable to use a page size larger than ordinarily encountered in handbooks. Standard letter size, 8½x11 in, was chosen; and by the method used for its binding, the book, in spite of its many pages, lies flat when open on a desk or drafting table and can be folded over and actually occupy less space than most other books when open. A detailed description of the origin of wood, its composition, manner of growth, physical, chemical and mechanical properties, behavior in service and why it is unsurpassed for thousands of uses would fill many volumes. The authors consequently chose to present conclusions, together with such informative discussion, as might clarify and aid in understanding the facts offered. The items chosen were limited to those which bear most directly on structural uses of wood. Publications and information from the Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, and standard works on mechanics of materials were used as sources of information. "Lumber Grade Use Guide," also recently released by the NLMA, and "Wood Structural Design Data" provide the user of lumber, first, with information on the proper selection of lumber, and, second, with the engineering data on how to use it to the best advantage.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EMPLOYMENT BULLETIN

An employment service is conducted by the American Society of Agricultural Engineers for the special benefit of its members. Only society members in good standing are privileged to insert notices in the "Men Available" section of this bulletin, and to apply for positions advertised in the "Positions Open" section. Non-members as well as members, seeking men to fill positions, for which members of the Society would be logical candidates, are privileged to insert notices in the "Positions Open" section and to be referred to persons listed in the "Men Available" section. Notices in both the "Men Available" and "Positions Open" sections will be inserted for one month only and will thereafter be discontinued, unless additional insertions are requested.

Men Available

ENGINEER, experienced on extensive mapping projects, drainage projects, construction projects, and the building of railroads in connection with sugar estates, also experienced with sugar mill and heavy construction and with all forms of hoists, etc., desires employment where his experience may be used. Will go anywhere, but prefers the tropical countries. MA-257

AGRICULTURAL ENGINEER desires position in farm structures or utilities field with college or commercial concern. Graduate of Iowa State College. Experienced in farm structures design, in the promotion and sale of building materials, in orchard work and in the manufacture of tractors. Employed at present. Age 26. Married. MA-258

AGRICULTURAL ENGINEER, with technical training and ten years' experience in general farm machinery operating, designing, and troubleshooting, five years' research and experimental work on cotton pickers and cotton harvesters, desires connection with an equipment manufacturing concern interested in adding cotton harvesting machinery to their line. MA-259

AGRICULTURAL AND ELECTRICAL ENGINEER, with bachelor of science degrees in both agricultural engineering and electrical engineering from the University of Wisconsin, desires employment (1) in rural electrification research with a college or experiment station, (2) in commercial work as rural service engineer or distribution engineer with an electric power company, (3) in development and engineering work with a manufacturer developing and building equipment for rural trade, or (4) in the educational field as an instructor or extension worker. Earned all educational expenses while attending college. Reared on a Wisconsin dairy farm. Two-years' experience in federal erosion control camps in Wisconsin in charge of concrete and construction work in erosion and flood control and land utilization. Assisting in instruction work in the agricultural engineering department, University of Wisconsin, at the present time. Location not important. Age 26. MA-260

AGRICULTURAL ENGINEER with bachelor's degree from University of Minnesota, born and reared on grain and dairy farm in southeastern Minnesota, with experience in large-scale farming in Montana and in artificial hay drying in New York, who knows the propagation, care, and planting of nursery stock and has some experience in erosion control work and in surveying work with the Coast and Geodetic Survey, desires employment for which his training and experience fits him. Age 28. Single. Location not important. MA-261

Positions Open

RURAL SERVICE ENGINEERS needed to fill positions in reorganization of rural electrification department of an electric light and power company. Their duties will be to promote the sale of electrical appliances in the rural areas, negotiate new lines, and work cooperatively with the manufacturers of electrical farm equipment. It is more essential that applicants have a practical knowledge of agriculture than electrical engineering. Salaries at start for these positions will be from $135.00 to $150.00 a month, plus transportation and expenses. Good oportunities for advancement. Write John S. Webb, director, rural sales, Philadelphia Electric Company, West Chester, Pa.